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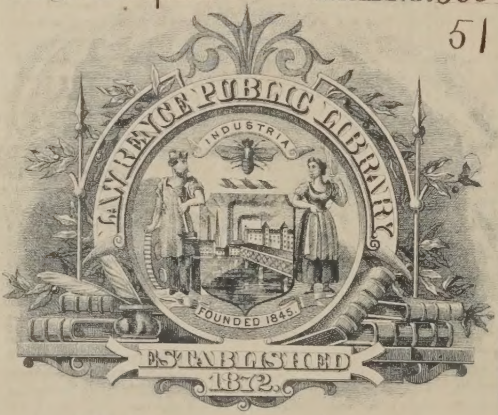

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APPLETONS' POPULAR SCIENCE MONTHLY

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VOL. LI

MAY TO OCTOBER, 1897

NEW YORK
D. APPLETON AND COMPANY
1897

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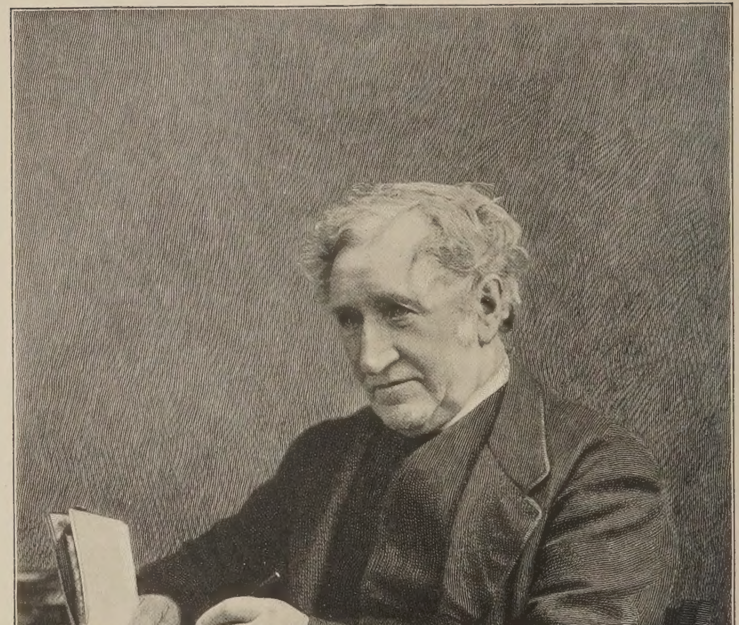

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APPLETONS'
POPULAR SCIENCE
MONTHLY.

MAY, 1897.

KOREAN INTERVIEWS.

By EDWARD S. MORSE.

DURING my residence in Japan I sought many interviews with Korean students, *attachés* of the Korean legation, and others, and in journalistic fashion asked them many questions concerning their country, people, habits, manners, customs, etc. At that time I found no Korean who understood English, but the younger men were studying Japanese, and so through them, by the aid of a Japanese interpreter, I managed to ask many questions of the older men. Since my return a number of opportunities have occurred—meeting Koreans who spoke English, and for several months I had a Korean as house companion. The information thus gained was not originally intended for publication, but for comparison with similar material of a cognate but far more advanced people, the Japanese.*

I may say here, though not as an excuse for any errors which may doubtless occur, that my questions could not have been more carefully asked, or the answers more promptly recorded, had I been on Korean soil. It is also proper to state that in every case the information was derived from Koreans of official position, and therefore the statements, so far as their own class is concerned, ought to be reliable.

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* It is an extraordinary fact that in the late war with China the Japanese, single-handed, overawed the Koreans, a hostile nation of at least eight million people, drove every Chinese soldier out of the country, and, had it not been for the interference of three powerful European nations, would have held the Regent's Sword, and would have supported the young Korean party in its patriotic efforts to regenerate that poor country. That the Koreans could not make the faintest stand against the Japanese, though aided by Chinese armies, leads one to wonder what manner of people are the Koreans, and this is my reason for publishing the following memoranda, disjointed and fragmentary as they are.

Family Relations.—The relations between the father and son are very strict, as between the king and the subject. If the son enters the room where the father is sitting, he must meekly stand with hands together until invited by his father to be seated; in sitting, he must lean forward in a humble attitude; he can not rise again without permission. He sweeps his father's room, makes his bed, and rises early to perform these menial services; he often gets up at midnight in solicitude for his parent's comfort. Filial love prompts these attentions, for fear the servants may grumble and complain and thus bring disquiet to the parent. In summer the son fans his father and attends minutely to every want; this same attention and respect are shown to his father's friends. Seasonal changes of clothing are not made until the parent's consent is given. It is considered exceedingly improper to cough, sneeze, eructate, or spit before old men. Boyhood continues until the fifteenth year, or until marriage; up to this time the hair hangs behind in a long queue; when manhood is assumed the hair is tied in a knot on top of the head. All the possessions of the children, as well as their earnings, belong to the father, and no matter how much the son may have the father can claim it all. If, however, the son lives in a separate house, he has the use of his earnings as well as his wife's dower; but if the father has no money, he may sell his son's house over his head and take all. Old men will not allow their sons to drink intoxicating liquors. From all that I could learn, the son is in abject enslavement to his father. After the death of the father the property goes to the oldest son. Brothers are very devoted to one another, and aid in supporting the less fortunate among them.

The daughters have a much easier time; they do nothing but eat and dress; they jest with their father and brothers, scold them, and act with great familiarity; indeed, all my inquiries about their behavior brought out the fact that they act like spoiled children.

Virtue is rarely lost among the more favored classes. Male and female servants do not sit down together or work in the same apartment. The wife is absolute mistress of the female servants. The apartments of the female servants are under a separate roof, and male servants never enter these apartments, though their duty is to clean the yard and garden belonging to the female servants. Servants are inherited by successors in the family; they are bought and sold. Loyal servants work and support their masters when they become poor. Masters can and do free their servants.

Education.—The higher classes employ private teachers. Children at the age of five or six begin the study of Chinese characters; they are provided with books for composition. Five rules of conduct are drilled into them; these are: To obey the father, respect the elder brother, be loyal to the king, be respectful to the wife, and be true to friends. These rules are strictly Confucian. After these rules are firmly fixed in the minds of the pupils they are taught to compose letters; next comes the study of history; after these studies Confucius and the Chinese classics are taken up, and finally the art of poetical composition. These studies go on through life. A gentleman will study classics in winter, composition of poetry in spring, and in summer study those subjects which will fit him for official duties. The king appoints judges to examine candidates for office; the number appointed may be three, seven, or twelve. The student for examination is locked up in a room for three days without books. The subjects usually selected for examination are from ancient poetry and classics, as follows: 1. Long-word poetry of seven words. 2. Short-word poetry of six words. 3. Problems in classics. 4. Clearing up doubts in classics. 5. Criticising famous men of olden times. 6. Considering what system of morality is best to correct or modify bad customs. 7. Suggesting what kind of military organization is best to defend and control the country. In these various examinations it is claimed that poetry reveals one's nature, that problems in classics show one's knowledge, that clearing up doubts in classics demonstrate one's powers of decision, that criticising famous men indicates one's knowledge of persons, that judging of the best system of morality and deciding as to the best kind of military organization displays one's mental attributes.*

In olden times Korea had public schools; for centuries it has had none. Private schools are kept in private houses; no special school building is known in the land. In many Confucian temples free classes are supported by the priests, but only Confucian doctrines are taught. Buddhists have no schools, but have stated times of teaching and expounding.

Position of Women.—The condition of women in Korea is unhappy and degraded to the last degree. Among the more favored classes the women are kept as prisoners within the house; in rare instances they may visit relatives. This seclusion begins after a girl reaches the age of ten or twelve. Four or five hundred years ago they had greater freedom. The women often refer to these times, and the intelligent classes express sympathy and pity for their present unfortunate condition. The seclusion of the women from the men is so strict that it is customary in the cities for the thatcher, before climbing to the roof, to shout in loud tones, "The thatcher is coming! the thatcher is coming!" so that the women in neighboring compounds may have a chance to run to cover.

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* The swindling and thieving character of Korean officials, their torturing and murdering subjects without trial, and the degradation and helplessness of Korea to-day, stand in curious contrast to this ennobling list of studies and examinations, and indicate a depth of hollow pretense and hypocrisy which is simply appalling.

Women are confined to domestic labor. Among the lower classes the husband has a right to beat his wife. There is no law for women. If she commits a crime, such as a personal assault or theft, she is not punished, but her husband is. A woman can pass in front of the king's procession, and the king must wait. The women are considered greater than men in trivial things.

Customs.—The chopstick is evidently not so commonly used in Korea as in Japan or China. A spoon is used for soup and all other forms of liquid food; even rice is eaten with a spoon. Dry food, however, is eaten with the chopstick. Guests of high rank sit midway between the two ends of the table. If two guests are present, they sit side by side. When at table the Koreans remain silent and eat very slowly. In passing food both hands must be used in holding the dish, as in Japan. In summer the meals are usually at seven, one, and eight o'clock. Dinner is at midday, though there is very little difference in the character of the meals. *Saké* is drunk at every meal.

The relation between master and servant is supposed to be the same as that between father and child. The servants help the master through the yard to his house and up the steps, and this attention is given whether the master stands in need of assistance or not. At dinner a servant ties a big napkin about the master's neck.

The Koreans have no music at weddings or funerals. (Contrary to this information, Carles records loud chanting at funerals.) On birthday festivities and times of feasting music is heard. They have battle songs and love songs.

The Koreans never tattoo or wear earrings, though in the western part of the peninsula prostitutes are sometimes seen with earrings. Women use paint for facial decoration. Men and women wear finger rings, but this custom is not very common with men.

An extraordinary feature is seen in the dress of women of the lowest classes, in the fact that the breasts are fully exposed. An abbreviated jacket drops from the neck to the upper part of the breast, while the waist of the skirt portion comes up just under the breast. The exposure of this part of the body seems all the more singular when it is considered that Koreans never go barefooted; even coolies working in the city do not go barearmed or barelegged. Women rarely wear a comb in the hair. Men and women do up their own hair.

Among the middle and higher classes it is considered improper to speak of money, and for this reason mathematics is not taught.

All openings in the house must be square. An arched doorway or window is not allowed except in the emperor's palace. There is a prohibitory law against decorating in any way the outside of a house, nor can the people build a house of over one story. Streets are named after trees, famous men, historical events which have happened on the ground, and attributes. Thus there is a Happy Street, Blessing Street, Virtuous Street, etc.

For centuries the fishermen of Korea have been accustomed to pour oil on the water to make the sea calm. The Japanese also follow the same practice.

MARRIAGE.—Koreans never marry cousins or any one descended from the same ancestors, or even any one of the same name. One of the most famous of Korean kings, Seijong Daiwang, four hundred years ago, said that intermarriages would cause the race to become extinct. It was this same king who invented movable type made of iron. Marriages are arranged by the parents. The bridegroom does not see the bride until the wedding. The groom goes to the bride's house and escorts her to his own house; after reaching the house they bow to one another standing. The bride then bows to the groom's father and mother and other relatives. She then offers wine and fruit to the groom's parents, and this represents a form of tribute. The relatives of both parties then have a great feast. When the groom goes to the bride's house he carries a paper from his father to the father of the bride, upon which is written, "I have a son, you have a daughter." He also carries with him two pieces of silk—one red, the other blue—each piece sufficient for a suit or dress. The red silk is wrapped in blue paper and tied with a red cord, while the blue silk is wrapped in a red paper and tied with a blue cord. The cords are tied in a peculiar knot called the "same-mind knot." Blue signifies the male principle, and red the female principle. This silk constitutes the wedding present, and is known as the "first cloth of ceremony silk," meaning the first present of her future husband. Dresses are afterward made of these pieces. When the wife dies the letter from her husband's father, above mentioned, is buried with her.

The first son derives his name from both parents; thus, if the father's name is Kum Pak and the mother's name is Chul Hei, then the boy's name will be Kum Hei. A boy may marry as young as fifteen years—that is, the ceremony may be performed then—but he does not live with his wife until he is eighteen. They may see each other, however.

Adultery is punished by fining both parties. For rape the offender is heavily fined and exiled for three years. Prostitution is recognized by the Government. Adulterers are often forced to be cooks in prisons and otherwise severely treated. Concubines are allowed by law, but the practice is considered bad, as it is liable to break up the family relations, and the finger of scorn is often pointed at the man. Rich men have concubines in secret.

Widows of higher classes never marry, though four hundred years ago they had the privilege of marrying again. This prohibition does not extend to the lower classes. Divorces are not permitted, but separation takes place in case of adultery; the man, however, can not marry again. Marriage with a slave girl is considered a great disgrace, and the friends of one who commits such an offense desert him. Children born of such a union, however, are not regarded with reproach.

Manners, Habits, etc.—The Chinese practice of medicine is in full force; the lower classes rarely employ a doctor, but ask the advice of gypsies. The people believe that all sickness is caused by evil spirits. Blind people find employment as devil expellers.

The liquors drunk are distilled and fermented from rice, corresponding to the Japanese *sochiu* and *saké*. An impure wine is made from oats; there is also a malt wine resembling ale. Liquors, cordials, or wines are made from bamboo, honey, peach, and pear mixed with *saké*. A wine is made out of the new twigs of the pine; there is also a wine called the *hundred-flower wine*.

A Korean gentleman of high rank assured me that it was considered impolite for children to say "Thank you" to their parents. Parents never thank their children, and at table the expression is not heard. The children eat at a separate table from their parents. It is considered impolite to smoke in the presence of another without asking permission and offering tobacco.

As an illustration of the rigid lines of propriety, a young man in the family is chided if he undertakes to make any addition or improvement to the house; he is told that such work is for the carpenter or cabinet-maker. He must attend to his books; he can not even invent or suggest any device.

Five hundred years ago the Koreans had paper money; this was very thick, and varied in size according to the denomination. Until within a hundred years they had gold and silver coins, lenticular in shape, like the checkers used in the game of "go." The coinage was abandoned by the Government on account of the extensive counterfeiting. The nobles now use these coins as checkers for "go."

The iron horseshoe was invented by a Korean general who fought against the Japanese invaders in 1596; before that time straw horseshoes were used, as in Japan.

It is customary to build large bonfires near pine forests, to attract and destroy moths, thus preventing destruction of forests.

Religion and Morals.—The general Government supports Confucian temples. In one temple there are over two hundred Confucian philosophers. Every county has its temple, with twenty or thirty Confucians. The Government stands in fear of these men, for they vigorously protest if rulers err in any way, and more particularly if their allowance is abbreviated. Confucius forbade the study of curious things as disturbing to the mind, and this ridiculous idea has grown into a superstition, and thus a man is prevented from preserving any relic dug from the ground for fear of a ghost following it. Previous to the fourteenth century the country was strongly Buddhist; since that time Confucian doctrines have spread from China, and within four hundred years Buddhists have been expelled from all cities and towns, and their temples have been destroyed. The priests can not even live in the villages, but must live in the mountains away from the villages. A certain Buddhist monument, thirty feet in height, was so beautiful that even Korean bigotry would not destroy it; it was cut halfway down, and the upper half was placed on the ground near the monument's base.

Pupils of Confucius are taught that if struck on one cheek they must turn the other, and if spat upon they must let it dry, for wiping it away would signify anger. Friendship is believed to be more faithful among Koreans, and the people are supposed to be more truthful than the Chinese or Japanese.

Burial.—The body when buried must be clothed in a shroud made of native cloth; this differs but slightly from the usual dress. A burial service is held, but no religious ceremony. Poor people hire a hearse, but a rich man will have a special one constructed. If the deceased cared for any special objects, these are buried with him—books, for example. The grave is dug to the depth of six feet. This depth is fixed for all. Books are published describing the forms of burial. The expenses of a funeral, with the construction of a tomb, a new hearse, etc., are often very great. The body may be kept in the house from three days to three months. Confucian doctrines enjoin a mourning period of three years, during which time no work is done. The king mourns seven days. A prominent feature of the mourner is a hat of large size, which comes down to the shoulders, thus concealing the face. The mourning color is yellow; it was formerly white. The clothing is always made of flax. No one ever accosts or interrupts a mourner on the street, and Jesuit priests often use the mourners' habiliments as a disguise.

Operative.—Among the various trades and occupations are those coming under the definition of silver- and goldsmiths, iron and bronze workers, builders and architects, wrights of various kinds, masons, decorators, artificers, weavers, saddlers, butchers, curriers, salt makers, a few seal engravers, plowmen, cattle and swine drovers, special thatchers and tilers, no barbers, but hairdressers, dyers, tanners, carpenters and cabinetmakers, and these latter go by the name of large and small carpenters. Craftsmen are not allowed to sell raw material; the lumber dealer, for example, would prevent a carpenter from selling even a board. There are also stone polishers, paper pasters, and tailors who make clothing by quantity. As in this country, such clothing is not considered as good as custom-made clothing. Women make their own clothing. Boys are not commonly employed, but are sometimes seen on the streets as peddlers. In Japan, on the contrary, boys are everywhere employed, and in all occupations, thus adding to the industrial strength of the nation. Men make shoes, though this is considered a mean occupation. Sandals are made by monks. As with us, there is a localization of industries and trades. A system of apprenticeship exists. In the first year's service the apprentice is fed, in the second year he receives half pay, and in the third year full wages are paid him; in the fourth year, if skillful, he becomes a partner in the work, or goes off by himself, the master helping him. The Government builds long markets in which are shops for special merchandise, such as silk, cotton, shoes, paper, etc. These are hired by merchants on perpetual lease, and the merchant who thus rents a shop receives all the trade in his specialty. Thus every one dealing in cotton must come to the cotton shop. A shop thirty or forty feet long will sell for five thousand dollars. Traders are accustomed to borrow capital from the nobles, upon which they pay interest. There are a great many guilds, which are called Brotherhoods in Trading. Partnerships are common. In the guilds, if one meets with a loss or failure all the others help make up the loss; in partnerships this is not so.

Public work is done by the co-operation of villages. In Séoul public work is done by the general Government, the city, however, collecting taxes for the work. If the people volunteer to do the work, no taxes are imposed. If the municipality does the work, then continuous taxes are collected; if the Government does it, the city is taxed for it. In the country, five days' work on public improvements is considered an equivalent for the tax.

In farm work no distinction is recognized between the sexes. Female domestics are employed in spinning, weaving, sewing, and universally in cooking; women even of high rank may cook with propriety; indeed, such service is considered quite legitimate for women of all ranks. Men never become cooks. In certain districts women make hats and straw mats. In the western part of the country silk is made, in the northern part linen, while in the southern part cotton is made. This kind of work is all done by women.

Regulative.—Co-operations are not hereditary, excepting those connected with the soil, such as mining, brick, tile and pottery kilns, etc. Farm labor is done by freemen and serfs. Serfs are called tributary slaves. The Government pays for its labor. During the times of great depression the Government orders certain work to be done as a relief to the people. Three kinds of public work are done—namely, by the Government, by the city, and by the people. For example, the people living near a river embankment may plant trees upon it (usually the willow, pine, or elm). Serfs in government employ work eight hours a day. In the Department of the Interior, and other departments, the king appoints a secretary or head officer, who in turn employs the subordinates. As an illustration of the shameful waste of time, it is customary for a force of employees to work by installments: thus, if thirty serfs are employed, ten of these work for three days only, then another lot of ten continues the work for three days, and finally the third set of ten takes up the work for the same time; thus, each set of ten have a week's vacation following three days' work. What wonder that the people are among the poorest on earth! There are two kinds of serfs, a higher and a lower kind. The higher serfs take their vacation in precisely the same way. The chiefs of departments have under their control not only various clerks, but also serfs who accompany the chiefs to their houses, and the chiefs may employ them on their own private work. There are no lawyers. Judges there are, and these are appointed by the king.

The commercial ways are very low. In some respects the methods are like those of nomadic tribes. Peddlers are called burden merchants, and travel through the country; if they have means they will buy their food; if not, they beg. They have no house or home, but with their families are traveling all the time. These people have very severe laws among themselves. Adultery is punished with death. When this crime is detected a letter is circulated among them. Hundreds assemble, and each one strikes the adulteress with a stick or club. They are very kind and polite among themselves. In many respects they resemble our gypsies, but are true Koreans, and are considered the lowest class. There are the other kinds of merchants who have no shops, but assemble in small towns on every fifth day to buy and sell. This is derived from an old Chinese custom. The higher classes of merchants have shops. Pawnbrokers abound, and auctions are common.

Festivals.—The last day of the old year and the first week of the new year are given up to festivities. The fifteenth day of the first month is called the New Moon holiday. A particular kind of food is made at this time, consisting of dates, chestnuts, honey, and cake rice (a peculiar kind of rice) boiled together. This food is called medicine food, and is supposed to be prophylactic and also to strengthen the brain. In the country, torches are lighted to welcome the moon, and people assemble in great numbers to catch the first glimpse of the moon, as it insures happiness. This day is also observed as All-Fools' Day. A favorite trick is to attach a flower secretly to some one's clothing.

In the second month, usually on the sixteenth, Butterfly holiday occurs. The third day of the third month is observed as the Flower holiday. On this day young men make cake of flowers mixed with wheat and rice, and this is fried; they also cook fish, and other articles of food.

The eighth day of the fourth month is called by the Buddhists the Washing-day of Buddha. Households have a lantern for each person, and these are supplied with oil lamps instead of candles, as candles are made of ox fat or honeycomb, and Buddha forbids the killing of animals. Oil for lamps is always a vegetable oil. The lower classes attend church on this day and sacrifice to Buddha. A cake is made of black beans, and this was formerly decorated with flowers; now this is rarely done, though artificial flowers are sometimes used for this purpose. At this time forms of animals are made of meal or lime and sold to the children.

The fifth day of the fifth month is called Swinging Day, and is derived from China. Swings are suspended from trees and frames, and everybody indulges in the sport. Boys put on their new clothes at this time. The root of the flag is cut with a sloping edge which is colored red, and this is worn in the hair to ward off calamities. (The Japanese have a holiday at this time, but have no idea of its derivation.)

The sixteenth day of the sixth month is observed as Hair-washing Day. Everybody observes the day except the laborer. At this time wheat cake and macaroni are eaten.

The seventh day of the seventh month is observed as a general holiday, and cake and macaroni are eaten. The holiday is based on the following story: Two stars in heaven were married; one was the daughter of God. Before marriage she was very industrious, but after marriage she became negligent and idle, and God, becoming angry, banished her to the eastern part of the Milky Way, while the male star was sent to the western part of the Heavenly River, as the Japanese call it. The woman had to weave, and the man had to attend cows. The female star is called the Weaver, while the male star is called the Patroller. They are allowed to meet once a year on this day. If it rains during the evening of that day it is interpreted as being caused by the tears of separation.

The fifteenth day of the eighth month is the Harvest holiday.

It forms a great festival for the farmers, and is much like a New England Thanksgiving Day. Gentlemen go to the country to see the festival, have food and wine, and generally get hilarious.

The ninth day of the ninth month is observed because the maple trees turn red and yellow flowers are in bloom. Poetry is written about the day and its beauties.

The tenth day of the tenth month is observed by every one making cake in the evening. Each one makes a number of cakes and presents them to all his friends. Friendship is supposed to be bound and strengthened by these gifts. Gentlemen engage in this pastime, and it is also a great day for the farmers.

On the eleventh month, at the winter solstice, a drink is made of red beans, and on this day sacrifice to ancestors is made.

On the twelfth day of the twelfth month people go hunting. Young men also call on the old men, who offer food and give good advice, and will say, "One year older, one year more." On this day the young man can sit down in the old man's presence and will listen respectfully to his advice.

Besides these stated festival days parties are often given, and if ten are invited, for example, provision must be made for three hundred, as each invited guest is accompanied by many servants, high and low. A large table is provided for each guest, and this is heaped with food and fruit, of which little is eaten, as most of it is given to the low servants, special tables being provided for the high servants. An ordinary party of this kind may often cost a thousand dollars.

A certain kind of picnic is called a "one-dish party." This is for men only, and each man brings to such a picnic a dish of some one kind of food sufficient in quantity for all.

GAMES.—The Koreans have dice, and cards of two kinds, with which several games are played, one being a gambling game, which is forbidden by law. They have chess, and "go," a peculiar game with four sticks, and also many puzzles. Children play ball by patting and bouncing it on the ground, have whipping tops, and fly kites. A portion of the kite string has broken glass stuck to it, and by this device they are enabled to cut the strings of other kites. (In Japan a device holding a sharp cutting edge is employed for the same purpose.) Children also play jackstones, using seven balls and having many ways of picking them up; these ways have their special names, such as "Hatch the chicken," "Laying eggs," "Making the kitchen," "Sawing wood," "Winnowing wheat," "Collecting eggs," "Striking ground," "Wearing the hat," etc. "Pease porridge hot" and "Cat's cradle" are also common; this last is called "Thread dipping."

SUPERSTITIONS.—It is believed that if a cat approaches a dead person the body will stand upright. In such a case it must be knocked down with a broom from the left. In Japan a similar superstition prevails. In eating rice (which is always eaten with a spoon), if the first spoonful is accidentally spilled it is a sign of bad luck. My informant's father often did this, and purposely challenged other superstitions as well, to show his contempt for them. In parties meeting together it is desirable to have an odd number, as in two, four, six, etc., there is an end, while in three, five, seven, and the like, there is no end; hence thirteen at the table is considered a lucky number. If a bride, in coming to her husband's house, stops on the threshold, it is a sign of bad luck. A horseshoe fastened over the door is to invite good luck. Bad dreams are, as with us, neutralized by saying that dreams go by contraries. If the hat is blown off by the wind it is a sign that something will be lost. In occupying a new house it is customary to have a woman, either the wife or a servant, enter first, carrying a bunch of matches; this insures prosperity, as a flame burning up. To avert infectious diseases, it is believed that a paper obtained from a priest and fastened over the door will be effective. A fierce face carved out of wood and placed over the door will drive away diseases which are supposed to be brought by the devil; also the burning of strong incense will have the same effect. Nothing can be removed from the house structure without vigorous protest from the womenfolks. (The women in Korea, as elsewhere, are the conservers of superstition. Old women, even in the higher classes, are superstitious, though there are some exceptions.) If the removed portion is to be replaced by other structures, then no objection is made, but to take anything away from the house structure without substituting something else is considered a bad omen. If a coal gathers on the lamp wick, it is a sign that one is to receive money, or some lucky windfall; so fixed is this superstition that many will not remove the coal. In Japan also this is considered a good omen. If the ear itches, it is a sign that some one is talking about you. If the chin itches, it is a sign that candy or cake will come as a gift. If one dreams of a Buddhist priest, it is a sign of being poisoned. A certain bird singing in a tree near the house presages the coming of a guest. If an owl hoots near the house, it is a sign that the master will soon die. If a fragment of tea floats vertically in the cup, it is a sign that a guest will come. If a candle is lighted in the middle of supper, it is a sign that the boys will get fierce wives. If money is found, it is considered a sign of bad luck, as it is gained without labor; an unexpected calamity will occur unless the money is spent before entering the house. If one accidentally places his spoon on the table upside down, it is a bad sign. If one's boot is upside down, it is considered bad; one will remain in the house if this happens rather than risk the consequences, which are, that he will lose something or be insulted. If both boots are wrong side up, it means nothing.

When lying down to sleep it is considered best to have the head directed toward the south. The head pointing toward the north is considered very bad. If the head is directed toward the south, it indicates longevity; to the east, happiness; to the west, success; to the north, short life. If one eats during lunar or solar eclipses sickness will follow. In Japan it is considered proper to remain indoors during eclipses. In Korea drums are vigorously beaten, to drive away the assailant of the sun or moon. This is a Chinese idea. An eclipse is observed by its reflection in a vessel of water. In Japan the same thing is done, because it is considered impolite to look directly at the eclipse. Shooting stars are supposed to be the excreta of stars. Farmers have an idea that the moon is trying to catch the sun, and if the moon ever overtakes the sun they will both fall to the earth, pressing the surface below the water, and thus the world will come to an end. A country philosopher told one of my informants that the sun was many hundred times larger than the earth, that the moon was three times larger than the earth, and that all the stars were much larger than the earth. Lightning is supposed to be the result of God looking angry, while thunder is supposed to be God scolding. It is considered rude to lie down when God is scolding. The lower classes believe that if insanity occurs three or four times in a year it is an indication of the devil's work. Gypsies are called in to drive the devil away by incantation. Intelligent doctors look upon insanity as the result of physical disease—namely, that the fire of the heart burns in excess. They also believe that some hearts are chilled, and that other hearts are empty. Cases of insanity are not common, and cases of idiocy had never been seen by my informant, though he had heard of instances. It is believed that when a certain river becomes filled with sand Korea will become powerful, and so it is a custom with many people in passing this river to throw in sand. The true-lover's knot is the same as ours. A ring around the moon is a sign that it will rain; the larger the ring the sooner the rain will come. The accidental breaking of a mirror is a sign that death will occur in the family. After the birth of a child persons can not enter the house for three days, nor can animals be killed for three days.

If a man's eyes have more white than black he will become foolish. Tapering or pointed fingers are looked upon as indicating dexterity. A long arm is considered an indication of wisdom, and its owner will occupy a high official position. In Japan the same peculiarity indicates a thief, which may be regarded as only another name for a Korean official. A large eye is a sign of short life. Physiognomists interpret many features of the face; thus a curved line extending from the lobe of the nose on each side is a sign of starvation.

Palmists also exist in Korea; thus the line of life in the left hand indicates long life, as it does in our palmistry; the same line in the right hand, however, indicates position. A line corresponding to our line of heart in the left hand indicates riches, while the same line in the right hand indicates power. The number of wrinkles at the base of the little finger, on the outside in the left hand indicates the number of brothers one will have, while in the right hand it indicates the number of sons to be expected. Other lines occur in the palm of the hand between the line of life and the line of heart, and these often have a fanciful resemblance to some Chinese character. A combination of these lines resembling the character for water is considered most propitious, because water is unlimited, and man can not do without it. Here the Korean chiromancer is far ahead of his Occidental brother in idiocy, for he can make out many ideograms in the fortuitous wrinkles in the center of the palm.

A familiarity with the language would undoubtedly reveal many peculiarities of expression; thus, for "Excuse me," they say "Do not blame me." "Naked truth" is called "Blood truth." Where we say "Neither hay nor grass," the Korean says "Neither calf nor colt." A house fly is called *parri* which means slanderer; the connection is obscure till it is explained that a fly leaves a light spot on a dark surface and a dark spot on a light surface. Among the sayings is "Rare as a white-headed crow"; in Japan it is a "horse's horn"; with us it is "hen's teeth." A mean man is one who gets his smoke by asking for a light from another man's pipe. In Japan the same expression occurs; also in Japan a mean man is one who finds his clogs in the dark by rapping his friend's head; the light emitted from such a blow is supposed to illuminate the vicinity. Our expression "The devil is always near when you are talking about him" is rendered in Korean "Even the tiger comes"; in Japan it is said "his shadow appears." A stupid fellow in Korea is called a "pumpkin face"; in Japan, a "pumpkin fellow"; with us he is a "pumpkin head."

MISCELLANEOUS.—Twins at a birth are not uncommon, but triplets are very rare. When the latter event occurs the Government makes a present of money to the amount of fifty dollars to the parents, besides furnishing rice for two months.

A Korean gentleman told me that when he first saw the Japanese he regarded them as savages, but was much struck with the convenience of their dress. Another informed me that his father sent him into the country to learn farming, at the same time instructing the farmer who was to have the care of him to provide only the ordinary food of the farmhouse. The young man's mother, however, used to send him secretly nice food and delicacies.

Among ignorant people the impression of the hand is signed as an autograph to legal documents, but never to marriage documents.

Human statues are not made at the present time, but in olden times figures of large size were sculptured in wood and stone.

Reddish hair and beard and blue eyes are not unknown; my informant had seen a number of such cases.

The classes of the people in Korea rank much as they do in Japan; they are in the following order: 1. Nobles. 2. A class like the Japanese *samurai*, which is inherited. 3. Soldiers. In Japan the teachers would come third, but they have no rank in Korea. 4. Farmers. 5. Merchants. 6. Coolies. 7. Butchers, peddlers, and gypsies.

Suicide is uncommon. When it occurs it is among the country people. Forms of suicide are usually hanging, the taking of poison, inhaling fumes of charcoal, and cutting the throat; the most usual form is that of hanging. My informant had never heard of more than four or five instances of suicide. Infanticide is not known. People in the western part of Korea often kill each other in fights. A curious story was told me by a Korean, who vouched for its truth. Two men, strangers to each other, were stopping at a hotel; one of them went away forgetting to pay his bill; the other paid his bill, and, on leaving, the landlord demanded pay for the one who had defaulted, supposing him to be his friend. This he refused to do, and a dispute over the matter led to a fight, in which the landlord was accidentally killed. The man who had forgotten to pay heard of the row and murder, and hastened back and inquired of the other why he killed the landlord. Explanations followed, and the forgetful man, in remorse at having been the cause of such a tragedy, killed himself; whereupon the survivor, in horror at having caused the death of two, immediately committed suicide.

A brutal sport is not uncommon wherein men engage in stone-throwing, and a number are often killed outright. It is considered a great feat if one can catch a stone and return it. They also fight with sticks and clubs. Boys imitate the men in these kinds of fights.

The Koreans regard their country as possessing eight remarkable objects: 1. An artificial pond thirty miles in length. 2. A mountain known as Kumgansan, having twelve thousand peaks of white stone. This may be the mountain known as Pak-tu, or White Head, which is likened to a piece of porcelain with a scalloped rim. The flora is said to be white, and the mammals white-haired. (If true, a case of protective coloration.) 3. A hole in the mountain from which the wind constantly blows. 4. A building in the southern part of Korea which has one room having the dimensions of one thousand squares; one square has the dimension of seven feet each way; the floor equals an acre in extent. 5. A beach composed of water-worn stones assuming the shapes of wild beasts, cattle, mountains, and other forms. (Objects of this kind are often seen mounted on little teakwood stands in Japan and China.) 6. A river called by a Korean name which means "against sand"—in other words, it is believed that the water flows in one direction while the sand runs in an opposite direction. 7. A flute one thousand years old, and only one man has been known who could play on it. 8. A stone Buddha.

An examination of Korean objects of manufacture, as exhibited in the United States National Museum, and in the Museum of the Peabody Academy of Science in Salem, will convince one of the degraded condition of the people. The rude musical instruments, rude pottery, rough work generally, and the almost complete absence of all industrial art handwork, testify to the alarming decay of the nation. Flanked as Korea is by China on the one hand and Japan on the other, with their advanced industries and skillful art handwork, and possessing, as Korea does, the records of a great past, the degradation and decay that have come upon the nation must have come about through their own fault. Repeated demands for an explanation of these conditions only brought out the answer that a noble could ruthlessly claim from the artisan any work he might do, and this without recompense. As a result, all ambition is crushed, and the workman dares not attract the attention of these official sharks by fabricating anything of special excellence. From hand to mouth they live; the masses are in abject poverty, and the only comforts they appear to command are heat and tobacco. The corruption of the official class makes Tammany officials seem like white-robed angels.

Conclusion.—If my various questions have been correctly answered, one may glance at the preceding statements and realize in how many ways the habits and customs of the people prevent work, discourage industry, and in a surprising number of instances encourage the survival of the unfittest. The appalling waste of time, the degrading habits of life, and the avarice and oppression of the official class illustrate in a forcible manner the result of unnatural selection. When one learns, for example, that custom, following Confucian doctrines, commands an industrious brother to waste his energies in supporting a number of idle, dissolute brothers, thus permitting them to survive to transmit their lazy and vagabond tendencies, one can easily understand the present degradation of the people.

Despite these lamentable conditions, there is a leaven in the nation which may work for regeneration if the accursed and sterilizing effects of Chinese influence and dominion can be rooted out of the land. I have met Koreans of the highest character, noble, unselfish, possessing every lovable trait and animated by the highest patriotism, and these men may yet be heard from in the councils of the nation.

THE RACIAL GEOGRAPHY OF EUROPE.

A SOCIOLOGICAL STUDY.

(*Lowell Institute Lectures, 1896.*)

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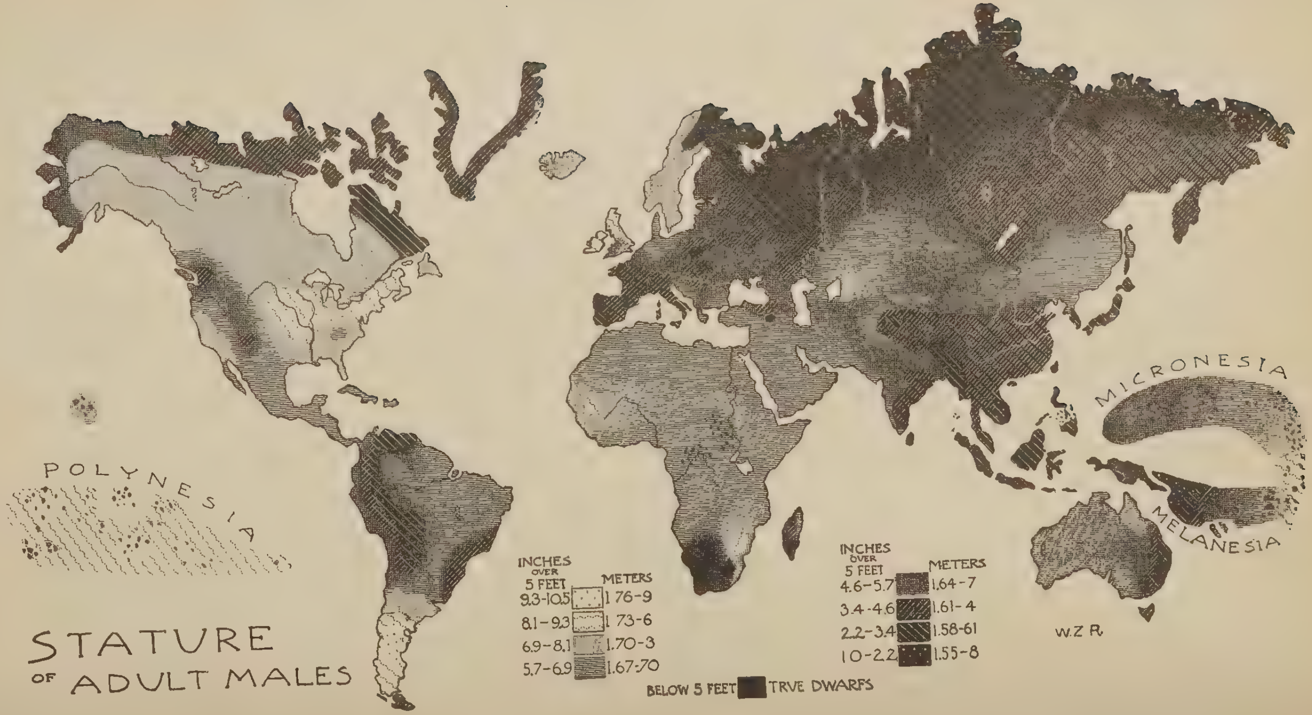
IV.—STATURE.

THE average stature of man, considered by racial groups or social classes, appears to lie between the limits of four feet four inches and five feet ten inches, giving, that is to say, a range of about one foot and a half. The physical elasticity of the species is not, however, as considerable as this makes it appear. The great majority of the human race is found restricted within much narrower limits. As a matter of fact, there are only three or four groups of really dwarfed men, less than five feet tall. Our map of the world shows a considerable area inhabited by the diminutive Bushmen in South Africa, and another large body of dwarfs occurs in New Guinea. The line of demarcation in the first case between the yellowish African Bushmen and the true negroes is very sharp; but in the East Indies the very tall and light Polynesians shade off almost imperceptibly in stature through Melanesia into the stunted Papuans. Other scattering representatives of true dwarf races occur sporadically throughout the Congo region and in Malaysia, but their total number is very small. On the whole, considerably more than ninety-nine per cent of the human species is above the average height of five feet and one inch; so that we may still further narrow our range of variation between that limit and five feet ten inches. We thereby reduce our racial differences of stature to about nine inches between extremes. These variations in size, it will be observed, are less than those which occur among the lower animals within the same species. Compare, for example, the dachshund, the St. Bernard, the Italian greyhound, and the smallest lapdog, and remember that they are all ascribed to the same species; or that the Shet-

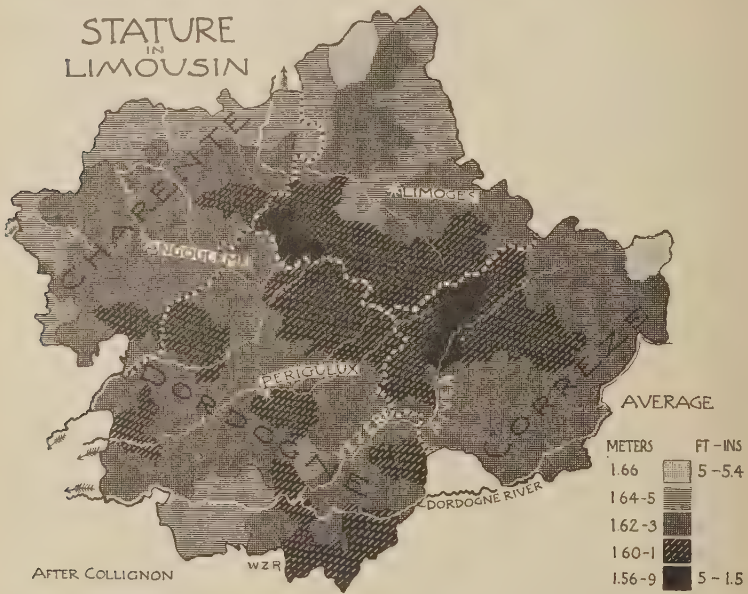

STATURE
OF ADULT MALES
POLYNESIA
MICRONESIA
MELANESIA
INCHES OVER 5 FEET
METERS
9.3-10.5
1.76-9
8.1-9.3
1.73-6
6.9-8.1
1.70-3
5.7-6.9
1.67-70
INCHES OVER 5 FEET
METERS
4.6-5.7
1.64-7
3.4-4.6
1.61-4
2.2-3.4
1.58-61
1.0-2.2
1.55-8
BELOW 5 FEET
TRVE DWARFS
W.Z.R.

land pony and the Percheron horse are likewise classified together. These abnormities are, to be sure, partly the result of artificial selection by man; but the same variation holds to a considerable extent among the wild animals.

The bodily height of a group of men is the resultant of a number of factors, many of which are as purely artificial as those concerned in the domestication of animals. These causes are quite as truly social or economic as they are physical or physiological. Among them we may count environment, natural or artificial selection, and habits of life. Beneath all of these, more fundamental than any, lies the influence of race which concerns us ultimately. This is overlaid and partially obscured by a fourth peculiarity manifested as a result of the sportiveness of Nature, whereby a large number of variations are due to chance, seemingly not caused by any distinct influences whatever. By scientific analysis we may eliminate this last factor, namely, chance variation. The first four causes besides race are more important and deserve consideration by themselves.

Among savages it is easy to localize the *influence of environment,* as it acts directly through limitation of the food supply. In general, the extreme statures of the human species are found either in regions where a naturally short race, like the Bushmen of South Africa, are confined within a district of great infertility like the Kalahari Desert; or, on the other hand, where a naturally tall race, like the Polynesians in the Pacific Ocean, enjoys all the material bounties which Nature has to bestow. It is probable that the prevalent shortness of the Eskimo and other inhabitants of the arctic regions is largely due to this factor. It is also likely that the miserable people of Terra del Fuego are much shorter than the Patagonians for the same reason. Scarcity or uncertainty of food limits growth. Wherever the life conditions in this respect become changed, in that place the influence of environment soon makes itself felt in the average stature of the inhabitants. Thus the Hottentots, physically of the same race as the Bushmen, but inhabiting a more fertile region, and, moreover, possessed of a regular food supply in their flocks and herds, are appreciably taller from these causes alone. All the aborigines of America seem to be subject to this same influence of the fertility of their environment. In the Mississippi Valley, for example, they are much taller than in the desert lands of Arizona and New Mexico. In the mountains on either side of the Mississippi basin, they are as a rule distinctly shorter, although living the same life and belonging to the same race. The Creeks and the Iroquois exceed the Pueblos by several inches, probably because of the material bounty of their environment; and where we find a single tribe, such as the Cherokees, inhabiting both the mountains and the plains, we find a deficiency of stature in the mountains quite marked by comparison.*

Among civilized peoples this direct influence of environment acts likewise through the food supply to affect the stature of any given group of men. Thus, in Europe as a rule, it may be said that, as among the aborigines of America, the populations of mountainous districts are shorter than those which enjoy the fertility of the plains and the river basins.† Wherever the geology of a district has produced a soil which yields with difficulty to cultivation, or where the climate is unfavorable to prosperity, the influence is reflected in the physical stature of the population. All over Europe we may locate such "misery spots," one of which will, however, serve as an example. It is depicted in the accompanying map.



AFTER COLLIGNON

This spot is likewise indicated in the south central part of France upon our general map for Europe, on page 30, by a small black-dotted area. This means a general average stature of five feet and two to three inches—a low level not elsewhere touched in France save in a little spot to the southwest of this, where similar conditions prevail. Here in Limousin there is a barren range of low hills which lies along the dividing line between the departments of Dordogne, Corrèze and Haute-Vienne, about halfway between Périgueux and Limoges. The water courses on our map show the location of these uplands. They extend over an area about seventy-five miles long and half as wide, wherein average human misery is most profound. Dense ignorance prevails. There is more illiteracy than in any other part of France. The contrast in stature, even with the low average of all the surrounding region, is clearly marked by the dark tint. There are sporadic bits of equal diminutiveness elsewhere to the south and west, but none are so extended or so extreme. Two thirds of the men are below five feet three inches in height in some of the communes, and the women are three or more inches shorter even than this. One man in ten is below four feet eleven inches in stature. This is not due to race, for several racial types are equally stunted in this way within the same area. It is primarily due to generations of subjection to a harsh climate, to a soil which is worthless for agriculture, to a steady diet of boiled chestnuts and stagnant water, and to unsanitary dwellings in the deep, narrow, and damp valleys. Still further proof may be found to show that these people are not stunted by any hereditary influence, for it has been shown that children born here, but who migrate and grow up elsewhere, are normal in height; while those born elsewhere, but who are subject to this environment during the growing period of youth, are proportionately dwarfed.*

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* Dr. Boas, in Verhandlungen der Berliner anthropologischen Gesellschaft, Sitzung von Mai 18, 1895, gives fine details on the American aborigines.

† Ranke, in his Beiträge zur physischen Anthropologie der Bayern, finds the mountaineers taller in his country; but Dr. Livi proves the opposite for Italy. *Vide* also Der Mensch, ii, p. 126.

We have referred in the preceding paragraph to another similar "misery spot" to the southwest of the Limousin hills. It is dotted black upon the map of Europe. The cause is here the same. The department of Landes derives its name from the great expanse of flat country, barely above the sea level, which stretches away south of Bordeaux. There is no natural drainage slope. The subsoil is an impervious clay. In the rainy season, water accumulates and forms stagnant marshes, covered with rank vegetation. At other times the water dries away, and the vegetation dies and rots. Malaria was long the curse of the land. Government works are to-day reclaiming much of it for cultivation and health, but it will be generations before the people recover from the physical degeneration of the past. Influences akin to these have undoubtedly been of great effect in many other parts of Europe, especially in the south of Italy, in Sardinia and Spain, where the largest area of short statures in Europe prevails to-day.

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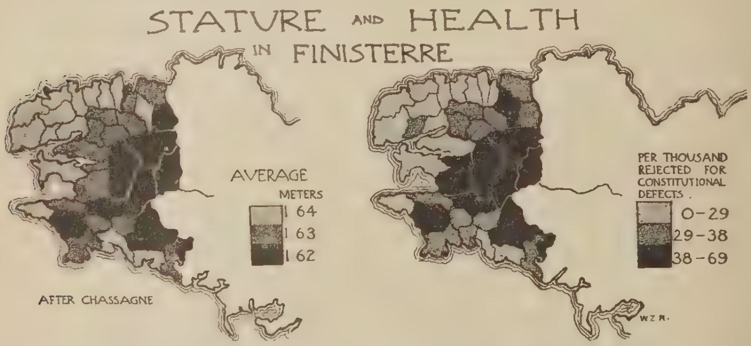
* Collignon in Mémoires de la Société d'Anthropologie, series iii, vol. i, fasc. 3, pp. 32 *seq.*

Environment thus acts directly upon stature through the food supply and economic prosperity. The second modifying influence lies in so-called *artificial selection*—a cause which is peculiarly potent in modern social life. The efficiency of this force depends upon the intimate relation which exists between bodily height and physical vigor. Other things being equal, a goodly stature in a youth implies a surplus of energy over and above the amount requisite merely to sustain life.* Hence it follows that, more often than otherwise, a tall population implies a relatively healthy one. Our double map, covering the westernmost promontory of French Brittany, shows this most clearly. In the interior cantons, shorter on the average by an inch than in towns along the seacoast, there is a corresponding increase of defective or degenerate constitutional types. The parallelism between the two maps is broken in but three or four instances. The map, in fact, illustrates the truth of our assertion far better than words can express it.


STATURE AND HEALTH IN FINISTERRE
AVERAGE
METERS
1 64
1 63
1 62
AFTER CHASSAGNE
PER THOUSAND REJECTED FOR CONSTITUTIONAL DEFECTS.
0-29
29-38
38-69
W.Z.R.

This relation between stature and health is brought to concrete expression in the armies of Europe through a rejection of all recruits for service who fall below a certain minimum standard of height, generally about five feet. The result of this is to preclude the possibility of marriage for all the fully developed men, during their three years in barracks; while the undersized individuals, exempted from service on this account, are left free to propagate the species meanwhile. Is it not apparent that the effect of this artificial selection is to put a distinct premium upon inferiority of stature, in so far as future generations are concerned? This enforced postponement of marriage for the normal man, not required of the degenerate, is even more important than at first sight appears. It implies not merely that the children of normal families are born later in life—that would not be of great moment in itself—it means far more than this. The majority of children are more often born in the earlier half of married life, before the age of thirty-five. Hence a postponement of matrimony means not only later children but fewer children. Herein lies the great significance of the phenomenon for us. Standing armies tend in this respect to overload succeeding generations with inferior types of men. This selection is, in operation, akin to the influence which Galton has invoked as a partial explanation for the mental darkness of the middle ages. This he ascribes to the beliefs and customs by which all the finer minds and spirits were withdrawn from the field of matrimony by the Church, leaving the entire future population to the loins of the physically robust and adventurous portion of the community. Mind spent itself in a single generation of search for knowledge; physique, bereft of intellect, was left to its own devices among the common people.

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* The two maps by Chassagne on Brittany are given in Revue d'Anthropologie, series ii, vol. iv, p. 440.

The intensity of this military selection, potent enough in time of peace, is of course highly augmented during the prosecution of a war. At such periods the normal men are not only isolated for an indefinite period; their ranks are permanently decimated by the mortality at the front. The selective influence is doubly operative. Fortunately, we possess data which appear to afford illustration of its effects. Detailed investigation in various parts of France is bringing to light certain curious after-effects of the late Franco-Prussian War. We do not always fully realize what such an event means for a nation, quite irrespective of the actual mortality, and of the direct economic expenditure. Every family in the land is affected by it; and the future bears its full share with the contemporaneous population. In France, for example, during the year of the war, there were seventy-five thousand fewer marriages than usual. In 1871, upon its conclusion, an unprecedented epidemic of them broke out, not equaled in absolute numbers since the veterans returned from the front in 1813, on the cessation of hostilities at that time.

Two tendencies have been noted, from the comparison of the generations of offspring severally conceived before, during, and after the war. This appeared in the conscripts who came before the recruiting commissions in 1890–'92, at which time the children conceived in war times became, at the age of twenty, liable for service. In the population during the progress of the war the flower of French manhood, then in the field, was without proportionate representation. There must have been an undue preponderance, not only of stunted men, rejected from the army for deficiency of stature alone, but of those otherwise physically unfitted for service. Hence, the population born of this time ought, if heredity means anything, to retain some traces of its relatively degenerate derivation. This is indeed the case. In Dordogne this contingent included nearly seven per cent more deficient statures than the normal average. Quite independently, in the distant department of Herault, Lapouge discovered the same thing. He found in some cantons a decrease of nearly an inch in the average stature of this unfortunate generation, while exemptions for deficiency of stature suddenly rose from six to sixteen per cent.* This selection is not, however, entirely maleficent. A fortunate compensation is afforded in another direction. For the generation conceived of the men returned to their families at the close of the war has shown a distinctly upward tendency almost as well marked. Those who survived the perils and privations of service were presumably in many cases the most active and rugged; the weaker portion having succumbed in the meanwhile, either to wounds or sickness. The result was that the generation conceived directly after the war was as much above the average, especially evinced in general physique perhaps more than in stature, as their predecessors, born of war times, were below the normal.

Another illustration of the operation of artificial selection in determining the stature of any given group of men appears in the physique of immigrants to the United States. In the good old days when people emigrated from Europe because they had seriously cast up an account and discovered that they could better their condition in life by coming to America—that is, before the days when they came because they were overpersuaded by steamship agents, eager for the commissions on the sale of tickets, or because of the desire of their home governments to be rid of them—in those days investigation revealed that on the average the immigrants were physically taller than the people from whom they sprang. This difference, in some instances, amounted to upward of an inch upon the average. Among the Scotch, a difference of nearly two inches was shown to exist by the measurements taken during our civil war. These immigrants were a picked lot of men—picked, because it required all the courage which physical vigor could give to pull up stakes and start life anew. This law that *natural* emigrants, if I may use the term, are taller than the stay-at-home average was again exemplified during the civil war in another way. It was found that recruits hailing from States other than those in which they were born were generally taller than those who had always remained in the places of their birth—that is to say, here again physical vigor and the adventurous migratory spirit seemed to stand in close relation to one another.*

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* For further details, *vide* the excellent analysis by Dr. Collignon, in Mémoires de la Société d'Anthropologie, Paris, series iii, vol. i, p. 36 *seq.*, and Dr. Lapouge, in Les Selections Sociales, pp. 208 and 234 *seq.* A most noteworthy treatise in many ways. *Vide* also Bulletin de la Société Languedocienne de Geographie, xvii, p. 355 *seq.*

In times of peace, perhaps the most potent influence of this form of artificial selection bears upon the differences in stature which obtain between different *occupations* or *professions*. The physically well developed men seek certain trades or occupations in which their vigor and strength may stand them in good stead: on the other hand, those who are by nature weakly, and coincidently often deficient in stature, are compelled to make shift with some pursuit for which they are fitted. Thus, workers in iron, porters, firemen, policemen are taller, as a class, than the average, because they are of necessity recruited from the more robust portion of the population. In marked contrast to them tailors, shoemakers, and weavers, in an occupation which entails slight demands upon the physical powers, and which is open to all, however weakly they may be, are appreciably shorter than the average. Moreover, certain diseases fall upon this second class in a way which tends still further to lower the average stature among them. Thus, consumption is uncommonly prevalent in these particularly sedentary industrial classes, and it is also more common among tall youths. It seems, therefore, that this disease weeds out, as if by choice, those who within this relatively stunted class rise above its average. As an extreme example of this selective influence exercised in the choice of an occupation we may instance grooms, who as a class are over an inch shorter than the British population as a whole. This is probably because men who are light in build and short in stature find here an opening which is suited to their physique. Their weight may nevertheless be often greater than the stature implies, because of an increase which has taken place late in life.

The final effects of this influence of artificial selection are highly intensified by reason of the fact that, as soon as the choice of occupation is once made, other forces come into play which differentiate still further the stature of the several classes. This is the last of our modifying influences upon racial stature, namely, the effect of *habits of life or of the nature of the employment*. Thus, the weakly youth who enters a sedentary occupation immediately becomes subjected to unfavorable circumstances as a result of his choice. If he chooses to take up the tailor's trade because he is physicaly unfitted for other pursuits, all the influences of the trade tend to degenerate his physique still further. Among these we may count the cramped position in which he works, the long hours, the unsanitary surroundings, etc. An active life conduces to growth and vigor, especially an active life in the open air. Denied all these advantages, everything operates to exaggerate the peculiarities which were due to natural causes in the preceding generation alone. This direct influence of the nature of the employment is probably the second principal cause of the great differences in stature which we observe among the several social classes in any community. At the head stand the liberal professions, followed in order, as our table shows, by the farmers and the commercial group, then by the industrial open-air classes, and finally by those who are engaged in indoor and sedentary occupations. The difference between these last two—namely, those who work in the open air and those who are confined within doors—amounts in Great Britain to upward of one half an inch upon the average, if we consider masons, carpenters, and day laborers as typical of the first class, and tailors and shoemakers of the second. As our table shows, the differences during the period of growth often amount to upward of two inches, greater among girls than among boys. As an extreme example of divergencies of this kind, we may instance a difference of seven inches between boys of fourteen in the well-to-do classes and those who are in the industrial schools in Great Britain. Later in life this disparity becomes less, as it appears that the

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* For most of the examples of social and economic differences in stature, I am indebted to Dr. Beddoe for his superb work On the Stature and Bulk of Man in Great Britain; to the Anthropometric Committee of the British Association for the Advancement of Science, report of 1883; to Roberts's Manual of Anthropometry; and to our American results given in Gould's Investigations in the Military and Anthropological Statistics of American Soldiers, 1869; and Baxter, in Medical Statistics of the Provost-Marshal-General's Bureau, 1875.

Average Stature in Inches (Great Britain).

No. of observations.	Age (males).	Professional class.	Commercial class.	INDUSTRIAL CLASS.	
				Country.	City.
3,498	15 years.	63·6	62·2	61·8	61·3
592	23 "	68·7	67·4	67·4	66·4
1,886	30–40 "	69·6	67·8	67·6	66·8

Averages by Occupations.

No. of observations.	Occupation.	Stature (inches).	Weight (pounds).
174	Miscellaneous outdoor	67·6	142·0
242	Clerks	67·3	136·7
834	Laborers	67·1	140·0
209	Iron-workers	67·1	140·0
135	Tailors and shoemakers	66·9	134·5
235	Miscellaneous indoor	66·7	132·5
101	Grooms	66·5	138·7

influence of factory life is more often to retard growth than to cause a complete cessation of it.

Interesting deductions might also be drawn from the relation of the height to the weight in any class, by which we may determine to some degree when and how these degenerative influences become effective. Thus clerks, as a class, are above the average stature, but below it in weight. This follows because these men are recruited from a social group where the influences during the period of growth are favorable. The normal stature was attained at this time. The unfavorable circumstances have come into play later through the sedentary nature of the occupation, and the result is a deficiency in weight. The case of grooms given above is exactly the reverse of this, for they became grooms because they were short, but have gained in weight afterward because the occupation was favorable to health.

These differences in stature within the community offer a cogent argument for the protection of our people by means of well-ordered factory laws. The Anthropological Committee of the British Association for the Advancement of Science delares, as a result of its detailed investigation, that the protection of youth by law in Great Britain has resulted in the gain of a whole year's growth for the factory children. In other words, a boy of nine years in 1873 was found to equal in weight and in stature one of ten years of age in 1833. This is nature's reward for the passage of laws presumably better than the present so-called "beneficent" statute in South Carolina which forbids upward of eleven hours' toil a day for children *under* the age of fourteen. In every country where the subject has been investigated—in Germany, in Russia, in Austria, Switzerland, or Great Britain—the same influence is shown. Fortunately, the advance out of barbarism is evidenced generally by a progressive increase in the stature of the population as an accompaniment of the amelioration of the lot of the masses, which is certainly going on decade by decade, absolutely if not relatively. There is no such change taking place among the prosperous and well-to-do. It is the masses which are, so to speak, catching up with the procession. It offers a conclusive argument in favor of the theory that the world moves forward.

One of the factors akin to that of occupation which appears to determine stature is the unfavorable *influence of city life.* The general rule in Europe seems to be that the urban type is physically degenerate. This would imply, of course, not the type which migrates to the city on the attainment of majority, or the type which enjoys an all-summer vacation in the country, but the urban type which is born in the city, and which grows up in such environment, to enter a trade which is also born of town life.

The differences in stature which are traceable to this influence of city life are considerable. The town population of Glasgow and Edinburgh offers an extreme example wherein the average stature has been found to be four inches less than the average for the suburban districts. The people, at the same time, are on the average thirty-six pounds lighter. Dr. Beddoe, the great authority upon this subject, concludes his investigation of the population of Great Britain by this statement: "It may therefore be taken as proved that the stature of men in the large towns of Britain is lowered considerably below the standard of the nation, and as probable that such degradation is hereditary and progressive."

On the other hand, it must be confessed that this unfavorable influence of city life is often obscured by the great social selection which is at work, as we shall hope to show later, in the determination of the physical type of the population of great cities. While the course of the town type by itself is downward, oftentimes the city attracts another class which is markedly superior, in the same way that the immigrants of the United States have been distinguished in this respect. Taking London as a whole, the stature of its people is apparently above the level of the surrounding districts, despite the unfavorable influences of urban life. At the same time the suburban counties about London are marked by a standard below the average. This follows, probably, from the great selective process by which all of the better types of the rural population are continually being drawn off into the vortex of city life. The effect of it is, of course, to increase the average stature of the town population, taken as a whole.

It would be interesting to inquire in how far the relative height of the *sexes* is due to a similar selective process. Certain it is that among us, in civilization, women average from three to four inches below men in stature, a disparity which is considerably less among primitive peoples. Dr. Brinton has invoked as a partial explanation, at least, for this, the influence of the law of sexual division of labor which obtains among us. This law commands, in theory, that the men should perform the arduous physical labor of life, leaving the more sedentary portion of it to the women. If the conscious choice of mates had followed this tendency, its effect would certainly be unfavorable to the development of an increasing stature among women, while it might operate to better the endowment of men in that respect. It is impossible, in the time at our command, to follow this out. Probably this difference of stature between the sexes is partially due to some other cause which stops growth in the woman earlier than in the man. The problem is too complex to follow out in this place.

From the preceding array of facts it will appear that in stature we have rather an irresponsible witness in the matter of race. A physical trait so liable to disturbance by circumstances outside the human body is correspondingly invalidated as an indication of hereditary tendencies which lie within. We are compelled for this reason to assign the third place to this characteristic in our series of racial tests, placing it below the color of the hair and eyes in the scale. This does not mean that it is entirely worthless for our ethnic purposes. There are many clear cases of differences of stature which can be ascribed to no other cause; but it bids us be cautious about judging hastily. It commands us to be content with nothing less than hundreds of observations, and to rigidly eliminate all social factors. The best way to do this is to take the broad view, by including so many individuals that locally progressive and degenerative factors may counterbalance one another. Turning back to our world map of statures, it will at once appear that we can not divide the human species into definite continental groups characterized by distinct peculiarities of stature. The so-called yellow Mongolian race comprises both tall and short peoples. The aborigines of America are, as a rule, tall; but in the Andes, the basin of the Columbia River, and elsewhere they are quite undersized. The only two racial groups which seem to be homogeneous in stature are the true African negroes and the peoples of Indonesia and the Pacific. In Africa the environment is quite uniform. In the other cases racial peculiarities seem to be deeply enough ingrained to overcome the disturbances due to outward factors. The Malays are always and everywhere rather short. The Polynesians are obstinately inclined toward tallness. With these exceptions, racial or hereditary predispositions in stature seem to be absent. Let us turn to the consideration of Europe by itself, and inquire if the same rule holds here as well.

The light tints upon this map* indicate the tall populations; as the tint darkens, the people become progressively more and more stunted. Here again we find that Europe comprehends a very broad range of variations. The Scotch, with an average height of five feet and ten inches, stand on a level with the tall Polynesians and Americans, both aboriginal and modern white. At the other extreme, the south Italians, French, and Spaniards, range alongside the shortest of men, if we except the abnormal dwarf races of Africa. From one to the other of these limits there is a regular transition, which again points indubitably to racial law. Two specific centers of tall stature appear, if we include the minor but marked tendency of the Dalmatians and Montenegrins along

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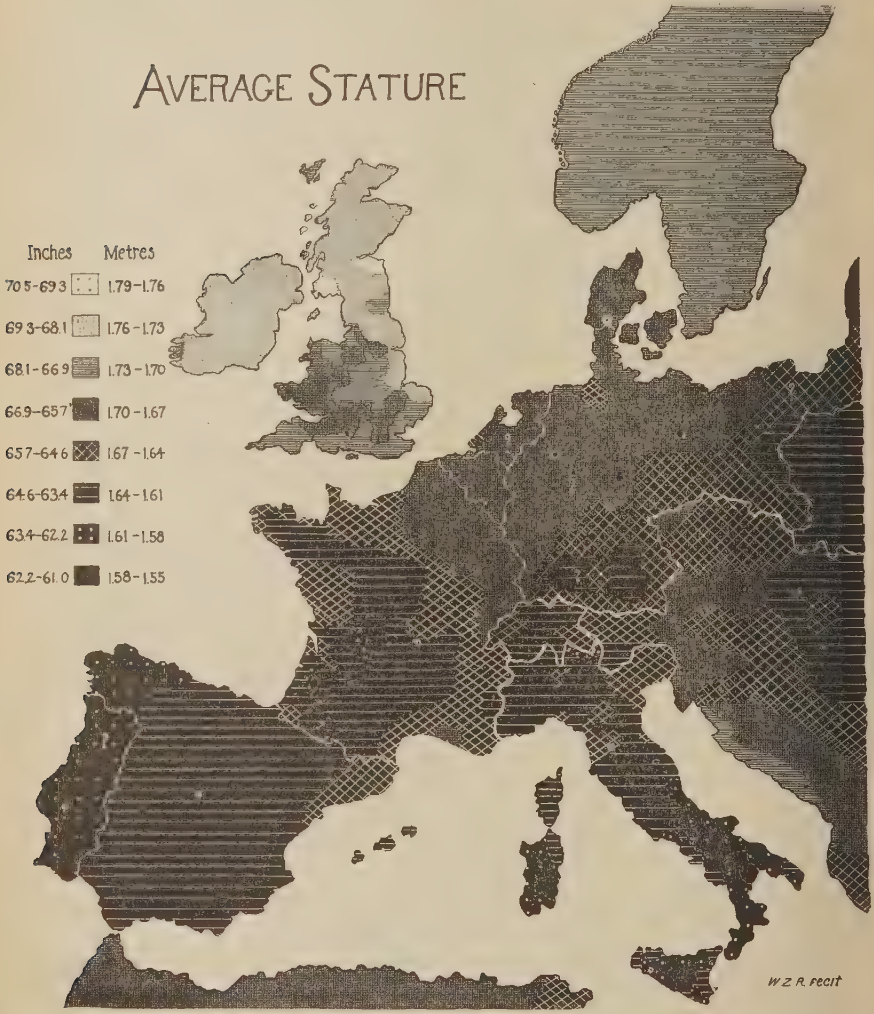
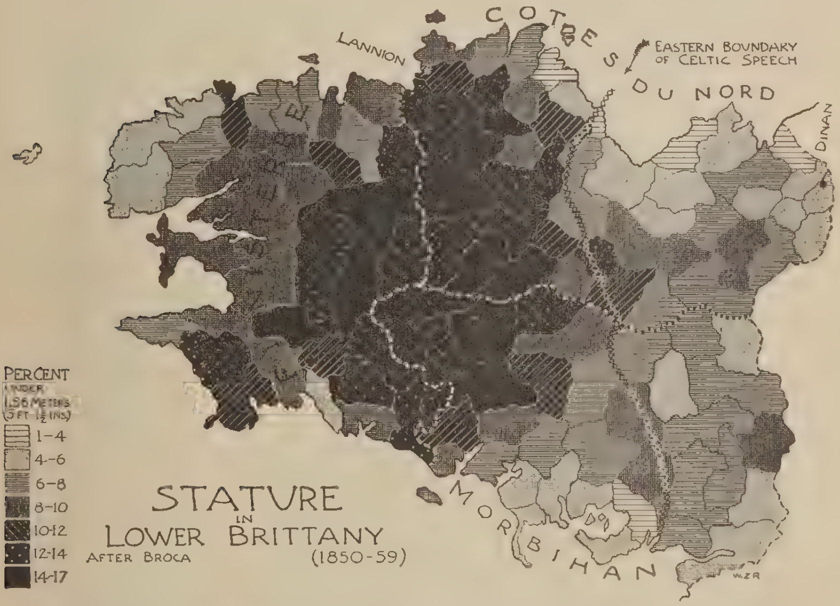
* This map is constructed from a great number of detailed local investigations, the results of which have been, as far as possible, correlated and reduced to a common base. Many serious difficulties have to be overcome, and the final result must be regarded as merely approximate. For example, some observers have studied the entire population of districts; others draw their figures from the army alone, from which, of course, all the abnormally short men have been eliminated. Some give averages alone; others work by percentile grades. To be sure, these two methods give parallel results; but how discover the average from them? Complete details will be published in due season.



the Adriatic Sea. The principal one lies in the north, culminating in the British Isles and Scandinavia. In Britain, economic prosperity undoubtedly is of importance, as the level of material comfort is probably higher than on the Continent. With this exception it appears that the Teutons as a race are responsible for the phenomenon. Wherever they have penetrated, as in northern France, down the Rhone Valley, or in Austria, the population shows its effects.

Central Europe is generally marked by medium height. The people tend to be stocky rather than tall. The same holds true as we turn to the Slavic countries in the east of Europe. Across Austria and Russia there is a progressive although slight tendency in this direction. The explanation of the extreme short stature of southern Europe is more problematical. Our map points to a racial center of real diminutiveness, at an average of five feet and one or two inches. Too protracted civilization, such as it was, is partly to blame. Some authorities, notably Lapouge and Fallot, even assert that naturally the people are as tall as the Alpine populations. Northern Africa certainly favors this view. We must await further investigation on this point, resting content with the fact, whatever the cause may be, that the average stature is exceedingly low to-day.


COTES DU NORD
LANNION
EASTERN BOUNDARY OF CELTIC SPEECH
DINAN
MORBIHAN
PER CENT UNDER 1.56 METERS (5 FT 1½ INS.)
1–4
4–6
6–8
8–10
10-12
12-14
14-17
STATURE IN LOWER BRITTANY
AFTER BROCA
(1850-59)
W.Z.R.

We may demonstrate the innate tendency of the Teutonic peoples toward tallness of stature more locally than by this continental method. We may follow the trait from place to place, as this migratory race has moved across the map. Wherever these "greasy seven-foot giants," as Sidonius Apollinaris called them, have gone, they have implanted their stature upon the people, where it has remained long persistent thereafter. Perhaps the clearest detailed illustration of the expression of this racial peculiarity is offered by the people of Brittany. Many years ago observers began to note the contrasts in the Armorican Peninsula between the Bretons and the other French peasantry; and especially the local differences between the people of the interior and those fringing the seacoast. The regularity of the phenomenon is made manifest by the preceding map. This is constructed from observations on all the youth who came of age during a period of ten years from 1850–'59. There can be no doubt of the facts in the case. It has been tested in every way. Other measurements, made twenty years later, are precisely parallel in their results, as we have already seen in Finisterre.*

The average stature of the whole peninsula is low, being only about five feet and five inches; yet in this "*tache noire*" it descends more than a full inch below this. This appreciable difference is not wholly due to environment, although the facts cited for Finisterre show that it is of some effect. The whole peninsula is rocky and barren. The only advantage that the people on the coast enjoy is the support of the fisheries. This is no insignificant factor, to be sure. Yet we have direct proof beyond this that race is here in evidence; this is afforded by other physical differences between the population of the coast and that of the interior. The people of the littoral are lighter in hair and eyes, and appreciably longer-headed; in other words, they show traces of Teutonic intermixture. In ancient times this whole coast was known as the "*litus Saxonicum,*" so fiercely was it ravaged by these northern barbarians. Then, again, in the fifth century, immigrants from Britain, who in fact bestowed the name of Brittany upon the country, came over in hordes, dispossessed in England by the same Teutonic invaders. They were probably Teutonic also; for the invaders of Britain came so fast that they literally crowded themselves out of the little island. The result has been to infuse a new racial element into all the border populations in Brittany, while the original physical traits remain in undisturbed possession of the interior. The Normans to the northeast are, on the other hand, quite purely Teutonic, especially marked in their height. In this case environment and race have joined hands in the final result, but the latter seems to have been the senior partner in the affair.

One more detailed illustration of the persistence of stature as a racial trait may be found in the people of the Austrian Tyrol, familiarized to us in the last paper. Unfortunately, our present map is constructed by different districts, so that we can not compare valley with valley, as it would be most profitable to do. We have to be content with more general results. For purposes of orientation we have reproduced upon this sketch the rivers shown upon our map in the preceding paper, so that certain comparisons may be drawn. We have already seen that the lower Inn Valley (uppermost in our map) was a main channel of Teutonic immigration into a primitively broad-headed Alpine country by race. On the south up the Adige Valley by Trient came the second intrusive element in the long-headed brunette Mediterranean peoples. This map at once enables us to endow each of these with its proper quota of stature; for the environment is quite uniform, considered as in this map by large districts covering valley and mountain alike. Each area contains all kinds of territory; so that we are working by topographical averages, so to speak. Moreover, the whole population is agricultural, saving a few domestic industries in the western half. Such differences as arise must be therefore in large measure due to race. The regular transition from the populations at the northeast, with generally a majority of the men taller than five feet seven inches, to the

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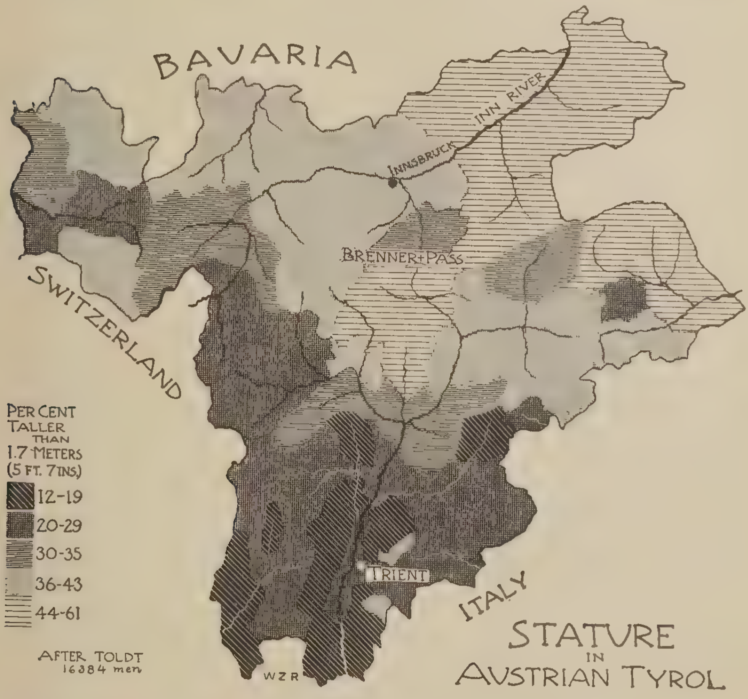
* Dr. Chassagne has maps almost identical with this, for the period 1874–'78. *Vide* Revue d'Anthropologie, second series, vol. iv, p. 439 *seq.* Our map is adapted from Broca's original results in Mémoires de la Société d'Anthropologie, Paris, series one, vol. iii, p. 186 *seq.*



STATURE IN AUSTRIAN TYROL

Italian slopes, where less than one fifth attain this moderate height, is sufficient proof.* The progressive decline goes on still further as we go south, as our map of Europe has indicated, away down to the toe of Italy's boot. Could demonstration in mathematics be more certain that here in the Tyrol we have a case of an increase of stature due to race alone? One of the most persistent traits of the Teuton is his bodily height. We in America, among the tallest people in the world, owe much of our advantage in this respect to our Teutonic lineage. The rest is due to the high level of prosperity enjoyed by the people in the United States as a whole.

REVERSIONS IN MODERN INDUSTRIAL LIFE.

By FRANKLIN SMITH.

PART SECOND.

I HAVE already shown how modern trade and professional corporations are a reversion to feudal corporations, which were the natural and spontaneous product not of legislative wisdom and philanthropy, but of chronic disorder, and how, for a time, they provided security for despised and plundered toilers, and promoted the growth of civilization. While pointing out the astonishing absurdity involved in the revival of such obsolete institutions in an age devoted almost exclusively to industrial life—a life based upon peace and the largest liberty compatible with justice—I described some of their more flagrant economic evils, the inevitable fruits of their alliance with the state and of their establishment of despotic monopolies. I shall now give an account of some of their moral evils, the fruits also of the same despotism; and though it will, as before, be confined chiefly to the plumbers, because they are the most powerfully organized and the most completely protected, it applies with like fidelity to all other trade and professional corporations sheltered behind a statute or a code of tyrannical rules and regulations.

I.

An optimistic essayist of the National Association of the Master Plumbers may boast that "protection has not only elevated the trade and eliminated from our ranks the incompetent and unworthy," but has "reached out and enhanced man's highest good, and given humanity the greatest benefactions of the age." He may boast also that in consequence of these noble fruits of protection, "the plumber receives the esteem, respect, and honor of his fellow-men, and enjoys the dignity and consideration given to the learned professions about him." * But the destruction of personal liberty and the establishment of a monopoly in labor and trade did not confer these blessings upon the corporations of the middle ages; they have not conferred them upon their modern successors. Brief as their history is, it discloses all the traits of their predecessors in embryo or in an advanced state of growth. They have not transformed human nature; they have not made it more honest, generous, or sympathetic. All they have done is to add another to the countless demonstrations that the reform of human society is not to come from legislation. They have provoked strife; they have stimulated deception; they have favored incompetency and dishonesty; they have discouraged character and excellence; they have created false hopes; they have produced indifference to the very dangers they were designed to guard against.

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* Details are given in Mittheilungen der anthropologischen Gesellschaft in Wien, vol. xxi, 1891, p. 69 *seq.*

The honest plumbers that expected most from this kind of legislation have suffered the greatest disappointment. The making of master plumbers, said Mr. Edward Braden, of San Antonio, Texas, at the Cleveland convention, "is a Herculean job. They love to go to conventions, have a good time, and even ridicule any advancement or strict enforcement of the sanitary laws." † So great does the task appear to be, and so vast is the work still to be done, that it must long remain incomplete. More than that, unless a different course is pursued, it must always remain incomplete. "It would seem," says another plumbing authority, "to be a safe assertion that too many [plumbers] do not have a true conception of the dignity of their calling. Their dominant idea is to do the cheapest work without much thought of the moral obligations resting upon them to guard in every way in their power the health of all concerned." ‡ The president of the Milwaukee convention complained that "in several instances parties, after becoming members of the National Association," have "endeavored to use their membership to keep other practical and worthy plumbers out." # Not finding the time ripe for such mediæval proscription, some of them have preferred to forego the benefits of the association. Other plumbers, equally oblivious to the "dignity of their calling," have been dishonest enough to conspire with the jobbers and consumers to violate the sanctity of the Baltimore resolutions. One of the more striking cases was the collusion of a plumber and jobber in one State with a consumer in another several hundred miles away. ‖ "Many

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* Proceedings, Cincinnati, 1891, pp. 129, 131. † Proceedings, Cleveland, 1896, p. 96.

‡ Proceedings, Washington, D. C., 1892, p. 80. # Proceedings, Milwaukee, 1893, p. 71.

‖ Proceedings, Cleveland, 1896, p. 145.

contractors," says the account of another case, which duplicates almost literally the experience of the Parisian *marchands de l'eau*,[*] showing again how independent of time and space, of feudal despotisms and despotic republics human nature is, "induce journeymen plumbers to take out licenses so that they can give the money to the journeymen and get the goods at plumbers' prices. Too often they do not go through the formality of having the money pass through the journeymen's hands. "It is to be regretted," adds the account mournfully, "that some supply houses sell to such so-called plumbers when they know the circumstances."[†]

As in the past, so to-day, the desperate attempt made to fence off trades and professions with the barbed wire of legislation, and to grant admission to the sacred circles of monopoly only to those that meet official standards of excellence, has led to the creation of absurd and arbitrary distinctions and provoked fierce anger and contention. Already the opticians of Pennsylvania distinguish between opticians, dioptricians, and ophthalmotricians,[‡] thus reminding one of the five kinds of hat makers in old France, and when they come to get a law enacted for their protection, these distinctions will doubtless be perpetuated in the statutes, to the instruction and amusement of some future Montesquieu. In the bill that the New York opticians have framed the line is drawn with scrupulous care between "dispensing opticians," who sell the products of the industrial skill of others, and "refracting opticians,"[#] who dispose of the products of their own skill. But hardly had the measure been published before there was a quarrel, or rather a series of quarrels, that rivaled any that the regulations of the French hat makers stirred up. There was, first, the fight between the regular physicians, who claim, by virtue of their diplomas from medical colleges, the right to prescribe for optical defects, and the oculists and opticians, who want to establish a monopoly of this business. Next came the fight between the oculists, who assert that they alone have the requisite knowledge and skill to practice their profession, and the "refracting opticians," who insist that they are just as competent to prescribe in certain cases. "When it is remembered that certain oculists," says the president of the New York State Optical Society, disclosing the bitter spirit that animates these two classes of "philanthropists" and "benefactors," "have elected to assault even skilled opticians by calling them quacks, charlatans, and fiery-eyed ignoramuses, we are certainly justified in refuting their allegations in a more gentlemanly and professional way."* Finally came the smothered conflict between the "dispensing opticians" and the "refracting opticians," who, although united for relentless war on the oculists, have widely divergent notions as to the character and limits of their own professional skill.

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[*] "Il est vrais que l'on employoit . . . bien de ruses pour éluder les lois rigoureuses imposées au commerce par le hanse. Les contrebandiers trouvoient dans le corps même des marchands de l'eau des hommes assez complaisans pour être les compagnons légaux des spéculateurs étrangers, et qui, dans le fait, se contentoient de prêter leur nom, sans prendre aucun part à la spéculation. Lorsque cette fraude étoit découvert, le prévôt de Paris condamnoit les marchands à l'expulsion de la communauté de hanse." (Règlemens sur les Arts et Métiers de Paris. Introduction. Par G.-B. Depping, p. xxxiii.)

[†] Proceedings, Cleveland, 1896, p. 37.

[‡] The Optical Journal, vol. ii, No. 8, p. 335. [#] Ibid., vol. ii, No. 10, pp. 391–393.

The same belligerent spirit exists between the plumbers and kindred trades. "A practical plumber, one who is concerned about elevating his profession," says a report from Delaware, "finds it exceedingly difficult in the small towns to compete with the tinsmith and hardware men." † The same complaint comes from Kentucky. "Nearly all of the plumbing in the smaller towns," it says, is "done by tinners, hardware men, machinists, and even 'nigger' blacksmiths." ‡ Could anything be more provocative of indignation and resistance in men possessed of a high spirit and noble aims? Afflicted as the feudal corporations were with illegitimate competition, they did not have to meet upon the field of honorable labor the ignoble rivalry of "niggers." The vice-president of the Oregon Association mentions as a particularly flagrant example of the unfair competition that the "honest plumber," one "concerned about elevating his profession," has to struggle against, a firm that advertises "Hardware, stoves, and ranges, sanitary plumbing, tin and sheet-iron work, groceries, provisions, and cord wood." "And still," he adds, as though recounting a miracle, but showing that honest work may be done without laws and ordinances, "these parties do a good job of plumbing." # Passing from the country to the city, where the evolution of industry has gone further and the lines that separate one trade or profession from another have become more distinct, the conflicts between plumbers and other occupations are more bitter and relentless. ‖ A stone mason is not permitted to build a drain under a house nor connect it with the sewer. Without the risk of arrest and prosecution a steam or gas fitter can not put in a water or waste pipe. To the hardware man is denied

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* The Optical Journal, vol. ii, No. 4, p. 119.

† Proceedings, Cleveland, 1896, p. 52.

‡ Ibid., p. 58.

Ibid., p. 54.

‖ The recent quarrel between the plumbers and gasfitters in New York city, which at one time threatened very serious consequences, grew out of the absurd question, decided by President Seth Low, who was made arbitrator, as to which trade had the right to put in the thermostatic attachment to radiators.

the right to connect the range he has sold with the water system of his patron's house.*

Although this intolerable despotism continues to grow by what it feeds on, and its complete abatement is not likely to come soon, there are not wanting some faint signs of revolt. The hardware men of Buffalo, N. Y., have refused to submit to it, and are engaged in a hot fight against the tyrants of the wrench and soldering iron. † As already indicated, the opticians of the State are also in rebellion against the oculists, having discovered in the benevolent legislation of these "social reformers" an attempt to enslave them. "Let us," says the president of the State Optical Society just quoted, summoning his followers to arms and defending his course with an argument equally cogent against all other assaults on personal liberty, "concentrate with the fearless determination to throw off the yoke which some oculists are so determined to have us wear by relegating us to a position of abject dependence upon them, and thus exposing ourselves to the exercise of a power which might, in a moment of emergency, make perjurers of all who lack the fortitude to resist it." ‡

But futile as has been the attempt to create the honest and competent plumber and to make him a national blessing, the effort to find the honest and competent official to enforce legislation and to rescue the public from the dangers of imperfect work has not been less prolific of disappointment. When I say that the failure has been signal and inevitable, I do not express the opinion deduced from first principles nor from every experiment with the black art of the lawmaker since its first dicovery. I express only the honest and unpremeditated convictions that plumbers themselves have reached. Even Mr. Spencer has scarcely described more vividly and effectively the political entanglements, the industrial paralysis, and the moral enervation that follow the practice of this system of modern magic. "It does seem impossible," said a Syracuse delegate at a State convention of master plumbers, after listening to a melancholy tale of the neglect of examining boards to do their duty, "to keep politics out of examining boards." * But the same trail is just as visible elsewhere. "You think it is the Board of Health," said an Albany delegate, showing how other officials have shirked their duty. "We have been there and made our complaint. They inspect the work brought to their office, they say. I have been to the corporation counsel and can not get any satisfaction. I have been to the district attorney and to the justice of the police court. They laugh at us." † This is the experience always had with the machinery invented to enforce the laws of any despot, be he French or American. The men that refuse to submit to them are too influential to be antagonized with impunity.

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* So intolerant have some plumbers become that it has been proposed to pass "a law making it a criminal offense for a person to hang out a sign, handle tools, or construct any part of plumbing work." (Remarks of Mr. Hosford, of New York. Proceedings, Pittsburg, 1889, p. 105.) A less intolerant but equally absurd and despotic proposition is that of the Michigan dentists. In a State Convention last year they passed a resolution in approval of an act for the appointment of a State dental examiner, whose duty should be to inspect the teeth of all children, and enforce such regulations as might be necessary to preserve the molars and bicuspids of the public. (Chicago Times-Herald, June 16, 1896.)

† Buffalo Courier, November 12, 1896. As further proof of the unselfish spirit that animates the plumbers of Buffalo, it may be said that for the work of connecting a range with the water pipes they charge from eight to twelve dollars. The hardware men claim that it is worth only three or four dollars.

‡ The Optical Journal, vol. ii, No. 4, p. 120.

Even if public officials possessed the Spartan virtue of Boyleau, who, according to the Sire de Joinville, yielded to no influence "*de parente, ni d'amys, ni d'or, ni d'argent*"; ‡ even if they were to enforce the law with Draconian rigor, it could and would be evaded. "'There are many ways of killing a cat besides choking him with butter,'" said Mr. Firmin at the Philadelphia convention, "and the law may be obeyed, while it is at the same time practically evaded and violated. No matter," he added, speaking with a professional knowledge that a layman would not presume to question, "how impartial, honest, and competent an inspector may be, in the very nature of things there are one hundred and one ways of putting his eyes out." # Could some legislative genius discover a way to prevent this loss of sight, protection from incompetent or dishonest plumbers would still be impossible. "There are a great many things," said Mr. Edward Schuster, of St. Louis, at the same convention, "necessary to a first-class job, which do not come under his supervision and which he is not responsible for, and yet they are of so much importance that they can not be omitted." ‖ Of what use, then, is a plumbing law? Of what use also are inspectors?

Still, the bottom of the Pandora box, which "philanthropists" and "benefactors" have stuffed with the evils of such legislation, has not yet been reached. While it does not benefit the honest plumber, it often screens the dishonest one. Here again I do not trust to the conclusions drawn from the doctrine of *laissez-faire*, nor from the unsupported assertions of prejudice. My statements are none other than those of the master plumbers themselves. "Plumbers imagined," said Mr. Dent Yates at the Detroit convention, "that the strictest ordinances (a few of which would make the framers of the Rhode Island blue laws weep with envy) would be a big bonanza. . . . But some of the self-same ordinances, designed to protect the good, conscientious plumber, have here and there acted as a screen for the quack plumber and fat for the ward bummer and the grog-shop politicians." * Is this not saying, as was once said to a French despot, that for every office he was pleased to make God was pleased to make a fool to fill it? With a touch of bitter disappointment over honest toil gone for naught, Mr. Firmin declared, in the essay quoted from already, that the plumbers that had "endeavored to be just to their fellow-men," that had "given their best thought" to "devising improved methods of practical sanitation," that "could point to the improved standard of plumbing as a part of their labors," had "not been rewarded in anything like a just ratio. . . . I might," he added in a tone of deeper disappointment, "even say in an everyday dollars-and-cents view," that they "have not directly benefited at all." †

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* Unpublished Proceedings, Buffalo, 1894, p. 59.

† Ibid., pp. 55, 56

‡ Biographie Universelle, vol. v, p. 436.

# Proceedings, Philadelphia, 1896, p. 91.

‖ Ibid., p. 94.

The most serious evil remains to be mentioned, for it falls upon the very persons whose benefit is, in the eyes of the "philanthropists" and "benefactors," its sole justification. Instead of making them more alert to protect themselves from the dangers that assail them and to secure the services of the most expert to aid them in this difficult task, it creates in them a state of indifference. Conscious that benevolent statesmen have made laws to keep them from harm, they fancy that it is no longer needful for them to take thought of the morrow. Plumbers themselves, with all their ardent faith in legislation, have not been able to shut their eyes to this peril. More than once have the thoughtful among them called attention to "overconfidence on the part of the architect and the general public" in "the cure-all-ism of the plumbing law." "This danger is at once serious to the public and to ourselves as business men," said the Sanitary Committee at the Philadelphia convention. ‡ "We found," said Mr. Firmin, also, "that the public has come to rely to a dangerous degree upon plumbing laws. . . . The danger lies," he added, "in the fact that the public believe that all plumbers, by virtue of the law's operation, are compelled to produce equal and certain results, and that if they have a certain piece of work to be performed it will make no difference whether they give the job to Jones or Brown. . . . Therein they fall into error, injuring themselves, as well as the honest plumber. They remove the incentive to progression and honesty." The Sanitary Committee takes the same view in almost the same words. "There has arisen a belief," it says, "that now it is not necessary to use care in the choice of your

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* Proceedings, Detroit, 1894, p. 169.

† Proceedings, Philadelphia, 1895, p. 91.

‡ Ibid., p. 43.

plumber, since he is by law compelled to comply with modern sanitary principles and mechanical arrangements. Never was a greater error committed by the public," with "far-reaching results for evil." * This, however, is only an expression of the truth that the public must, in spite of all supervision, look after itself.

But, like a nobler sentiment, faith in the efficacy of legislation for the cure of all social ills, including those from incompetent barbers and horseshoers, "springs eternal in the human breast." It is not enough that such a law as the plumbing law can not be enforced; that, even if it were enforced, it would not yield the benefits that its framers anticipate; that, instead of favoring the honest plumber, it favors the dishonest one, and enables the unscrupulous politician to bribe or coerce constituents; that, instead of promoting the interests of the public, it is a detriment to them, producing a false sense of security perilous to health—it is still proposed to follow to the death the same *ignis fatuus*. To be sure, the most advanced "philanthropists" and "benefactors" do not propose to enact more rigorous municipal regulations or more elaborate State laws. These have failed. But they propose to resort to the great panacea of periodic inspection and national legislation. Preparing the way for the exercise of the last hope of the apostles of benevolent despotism, the Sanitary Committee of the Philadelphia convention declared that "no matter how thorough and complete" a piece of plumbing may have been done, "Nature, assisted by use, abuse, and neglect, will render that which was perfect most imperfect." † It then proceeds to urge with fitting solemnity "the very great importance of legislative action looking to and providing for periodic expert examination of sanitary appliances." That is to say, since people can not be trusted to keep their plumbing in order, the State must, like a policeman, compel them to do so. "A system of laws emanating from Congress," says an authority quoted with approval by the same committee on another occasion, after pointing out, among other things, that "the laws enacted by State and local authorities are continually subject to change according to the whim of any petty politician who sees his self-aggrandizement in any movement that may please a portion of his constituency," "would obviate all such trouble. . . . Such laws would be enforced by the State and local boards of health, and, in case of their failure or neglect, such attention and assistance from the national powers should be given as the circumstances of the case may require." * That is to say, again, a defective principle inoperative on a small scale can be made a success on a large one. Although a despotic local law can not be enforced, a despotic national law will be scrupulously observed. If local officials can be blinded in "one hundred and one ways," national officials are subject to no such impairment of vision.

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* Proceedings, Philadelphia, 1895, pp. 43, 44. "The committee did not believe, however, that national legislation on the subject was desirable. It said: 'In the nature of things, it is impossible to form laws which would be equally appropriate to all sections of the country; that which would be best suited to the needs of Michigan would prove most faulty for Louisiana. A system approaching perfection as applied to California would be ridiculous if applied to Maine' (p. 43). But, as shown in the text, this sensible view was repudiated by the committee in the following year. It was crushed under what Mr. Spencer has fitly characterized as the momentum of the socialistic movement."

† Ibid., p. 44.

II.

But this is only a fresh illustration of the pathetic faith of the chronic invalid, ever on the search for a new pill or a new tonic. A change from one despotism to another, or from one set of officials to another, will not deliver society from the defects of human nature. Much less will that blessing come from the increase of despotism and the multiplication of officials. Such quackery has been tried from the dawn of Greek democracy down to the latest product of popular sovereignty—the Brazilian Republic. It has failed; it must inevitably fail. It violates a law of social development as immutable as the law of gravitation, one that punishes those that fail to heed it with equal certainty and severity. I refer to the law set forth by Mr. Spencer that the more peaceful and industrious a nation becomes, the less is its need of the restraints of either custom or legislation. But of this matchless induction of modern science the social reformers of to-day have no conception. They act upon the assumption that the world has made no headway in a thousand years; that men are still barbarians and require the shackles of an age of disorder; that there must be the official mechanism of an old French or Prussian despotism, which had no other use than to recruit and drill troops and to wring taxes from despised and impoverished toilers. But since the days of feudal chaos humanity, despite the obstacles thrown in its path by ignorance and interest, has gained ground. Men have outlived the rules and regulations of a military despotism. They do not pay homage to the occupant of a throne, surrounded by courtiers as intent on the plunder of subjects as soldiers on the plunder of enemies. Their allegiance is to another ruler, which, though less regal, is not less powerful; it is conscience, the embodied restraints that come of peace, sympathy, and culture.

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* Proceedings, Cleveland, 1896, p. 31.

If the obedience due this ruler of the modern industrial world is imperfect, the reason is not difficult to discover. It is because his reign has been brief, and human nature is still crude. Too many vestiges of countless ages of conflict cling to the brain of man. Too much misdirected effort is made to fit the institutions of murder and pillage to times of peace and industry. Obsolete as a battle axe or a coat of mail, they do not extinguish the traits inherited from savage ancestry; they only stimulate and perpetuate them. No matter whether they be tried under the despotism of a French feudal monarchy or under the popular sovereignty of the American Republic, the effect is identical. They engender the same greed, the same hypocrisy, the same deception, the same contention. No abridgment of liberty that philanthropists or statesmen may deem essential to the safety of modern civilization will permit them to realize their Utopian dream. The millennium lies in another direction—in the direction of greater liberty. As society becomes more and more complex, with wants so great and varied as to pass the knowledge of any benevolent despot ruling by divine right, or any group of despots ruling by virtue of universal suffrage, individuals must be allowed more and more to control their own destiny, and to take the consequences, good or bad. Whatever government they may need to direct their countless enterprises for the supply of those wants and for the regulation of their relations with one another and with the public, must not be the product of political selection, but of industrial selection; it must not be the choice of ward bummers and complaisant citizens that register the will of an unscrupulous and irresponsible demagogue, ambitious to exercise a power that decent people refuse him, but of the men that have staked their fortunes in business, whose success or failure is dependent upon the wisdom of their action. Not the least fit, but the most fit, will then administer the affairs of the world. With the continuance of peace and industry they will not be the greatest fools or knaves, now so often charged and unhappily so often proved, but the wisest and most upright. Civilization will not then go backward, as it now threatens to do, but it will go forward, as it did with the enlargement of liberty that has been the most splendid achievement of the last four centuries of thought and effort.

THE eager haste with which men of fixed notions are apt to rush to conclusions is portrayed rather than caricatured in Lord Houghton's version of the debate between Huxley and Bishop Samuel Wilberforce in the British Association in 1860, which Sir E. Grant Duff quotes in his Notes from a Diary. As the story is told, Mr. Huxley asserted that the blood of guinea pigs crystallizes in rhombohedrons. "Thereupon the bishop sprang to his feet and declared that 'such notions lead directly to atheism.'"

PRINCIPLES OF TAXATION.

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VII.—RULES OR MAXIMS ESSENTIAL TO AN ADMINISTRATION OF RIGHTFUL TAXATION UNDER A CONSTITUTIONAL OR FREE GOVERNMENT. PART II.

IN continuance of the discussion entered upon in the preceding part of this chapter, as to whether under a constitutional and free government, and in virtue also of the natural and inalienable rights of the people governed, a state has a lawful right to levy and expend taxes in furtherance of private interests, more especially by way of bounties, the following additional points may be worthy of consideration:

Probably no better exposition of the limitation on the exercise of the taxing power incumbent on a free government professing a regard for the rights of the people, and more especially on the Federal Government of the United States, under its Constitution, in respect to the granting of payment of bounties for the promotion of the private interests of any of its citizens, can be found than the following, accredited to Justice Thomas M. Cooley:

> "It is not in the power of the state, in my opinion, under the name of a bounty, or under any other cover or subterfuge, to furnish the capital to set private parties up in any kind of business, or to subsidize their business after they have entered upon it. A bounty law of which this is the real nature, is void, whatever may be the pretense on which it may be enacted. The right to hold out pecuniary inducements to the faithful performance of public duty in dangerous or responsible positions stands upon a different footing altogether; nor have I any occasion to question the right to pay rewards for the destruction of wild beasts and other public pests, a provision of this character being a mere police regulation. But the discrimination by the state between different classes of occupations, and the favoring of one at the expense of the rest, whether that one be farming or banking, merchandising or milling, printing or railroading, is not legitimate legislation, and is an invasion of that equality of right and privilege which is a maxim in state government. When the door is once open to it there is no line at which we can stop and say with confidence that thus far we may go with safety and propriety, but no further.
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> "Every honest employment is honorable; it is beneficial to the public; it deserves encouragement. The more successful we can make it the more does it generally subserve the public good. But it is not the business of the state to make discriminations in favor of one class against another, or in favor of one employment against another. The state can have no favorites. Its business is to protect the industry of all, and give all the benefits of equal laws. It can not compel an unwilling minority to submit to taxation in order that it may keep upon its feet any business that can not stand alone."

A brief historical retrospect is here pertinent to this subject. The payment of bounties from the proceeds of taxation, or rather of exaction, is a relic of the commercial methods of the middle ages. They were, however, regarded as legitimate fiscal expedients for the encouragement of trade and domestic industries during the whole of the last (eighteenth) century; but since then, under the influence of a higher civilization and modern economic ideas, have been almost entirely discarded from the fiscal systems of the leading commercial nations until within a comparatively recent period, when they have been revived and made mainly applicable to the production and sale of a single one of the world's great commodities—namely, sugar;* and the history of this experience constitutes a most interesting and instructive chapter in economic history.

Although the practice of stimulating the production of beetroot sugar in Europe through high protective duties on imports and export bounties dates back to the first quarter of the century, the present complicated and curious state of affairs is really due to a method of taxing beet sugar by Germany which was adopted in 1869. The idea involved in this method was, in brief, to collect an excise or internal-revenue tax on all sugar produced, and give a bounty on so much of the domestic product as was exported or sold to the people of other countries. The other states of continental Europe, finding the markets of their own product of beetroot sugar everywhere supplanted by the German sugars, and their domestic manufacturers being thereby brought to the verge of ruin, made haste to follow the example of Germany, until the policy of Germany, France, Belgium, Holland, Austria, and Russia seems to have been to stimulate their domestic product of sugar to the greatest extent, and then enter into competition with each other to see which of them could sell cheapest to foreigners at the expense of their own people. The general result is, that the great beet-sugar industry of Europe has been established and is now conducted on what may be regarded as an artificial basis, and one not inaptly characterized as a most ingenious method for entailing money losses on the mass of the people of the countries above mentioned.

The immediate sequence of this policy has been an enormous increase in the beet-sugar product on the Continent of Europe—i. e., from 2,223,000 tons in 1885–'86 to nearly 5,000,000 (4,789,000) tons in 1895–'96—with such a reduction in price that the whole sugar industry of Europe is seriously depressed, with a general complaint on the part of producers that the amount received by them does not cover the cost of production. Under such a condition of affairs, the German Parliament (Reichstag), in May, 1896, accepting a popular declaration that "sugar was the last and only agricultural product in which there remained any profit for the German farmer, and that whatever skillful legislation could do to preserve and protect that industry should in justice to the suffering landowners be given a prompt and thorough trial," passed an act increasing the bounty on the export of sugars to an extent assumed to be sufficient "to enable German exporters to compete against all comers in foreign markets"; advancing the import duty on sugars to a prohibitory degree; and fixing an internal-revenue tax on sugars to such an extent as to yield a net income to the state in excess of its disbursements on account of bounties on exports. The effects of the new statute have now become apparent and ominous. The foreign sugar market has responded to the increased bounty export by a proportionate decline in price; and a movement now finds favor to petition the Reichstag to make certain amendments in the existing statute so as to restrict instead of stimulating production, and to invite international negotiations for the gradual abolition of all export bounties, which have been proved to be simply a burden on the treasury, which pays them for the benefit of non-producing foreign countries.

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* The policy of payment of bounties for the encouragement of shipping and of shipbuilding enterprise has also, to a limited extent, been established, more especially by the two Governments of France and Italy.

The present burden which the sugar-bounty system entails upon the taxpayers of Europe is estimated at about $25,000,000 per annum, while the excise tax on sugar in Germany, France, and Austria is said to amount to $100,000,000 per annum. On the sugar consumed by the people of the continental nations of Europe which have adopted the bounty policy there is no bounty, but on the contrary an excise tax; the result of which legislation is to make exported sugars very cheap and home consumption abnormally dear. This is demonstrated by reference to the statistics of the comparative consumption of different countries. Thus in England, whose policy since 1874 has been to give her people sugar free of taxation, the *per capita* consumption has risen from fifty-six pounds in that year to eighty-six pounds in 1896; while the saving to the British people from the reduction of the cost of this one item of their living has been estimated to be at least £6,000,000 ($30,000,000) per annum. The great reduction in the price of sugar has also given a remarkable impetus to the British industry of manufacturing sweets, in the form of confectionery, preserves, jams, marmalades, etc., which last to a considerable extent have undoubtedly supplanted the use of butter. The present annual average consumption of sugar in Germany is reported to be about twenty-seven pounds *per capita*. In France the declining consumption of sugar has been made the subject of recent debate in the Chamber of Deputies, where the question was pertinently asked by one of the deputies (M. Méry) if the object of the existing governmental policy in respect to sugar "was mainly to produce it or to have and enjoy it." The Agricultural Society of France has also recently unanimously indorsed a demand of the French sugar makers and refiners that the Government should increase the present bounty on the export of sugar to an extent equivalent to the combined or aggregate bounties allowed in Austria and Germany.

So much, then, for nearly half a century's experience on the part of the leading continental nations of Europe in attempting to regulate the production, price, and consumption of sugar through a system of bounties.

Practical experience in respect to the employment of bounties also leads to a deduction, which may be almost regarded in the nature of a principle, that when bounties are employed for the promotion of some public good, the object sought eventually becomes subordinate to the opportunity which an unnatural and unprincipled perversion of the bounty provisions affords for the promotion of private rather than public interests. The following illustrations, though somewhat comical in their nature, serve to sustain this proposition:

In the early years of the present century the State of Connecticut, having in view the promotion of its agricultural interests, offered a premium on the destruction of the crow; to be paid on the production of the head of the bird to the proper authorities. Thereupon the sons of the farmers, desirous of earning a little money, then much more difficult to obtain than at present, diligently searched the woods for the nests of crows, from which at the proper time the eggs were transferred to sitting hens, by whom they were hatched and the resulting offspring brought up until their heads became available for presentation and procurement of the bounty. A summary of the general results of such experience would be somewhat as follows: First, a perversion of the legitimate industry of the hen; second, an elementary lesson for young persons in perpetrating frauds against the State; third, an impairment of the agency of a bird, whose habits have been proved by subsequent scientific investigations to be beneficial rather than detrimental to the interests of the farmers. Again, in the early history of one of the Northwestern States of the Federal Union a bounty was offered, at the request of the farmers, for the heads of little burrowing animals known as "gophers," which attracted little attention till the experience of several years showed that the disbursements of the State on this account had become abnormal and were rapidly increasing. Investigation then proved that the raising of gophers by citizens of the State for the procurement of bounties had become a regular industry. A like experience in British India is also worthy of note. Some years since the Government, with a view of arresting the mortality among its native population from the bites of poisonous serpents, offered a bounty on their proved destruction; when it was found that for the sake of obtaining the bounties the cultivation of the "cobra" and other like snakes had been actually entered upon.

Third. *The sphere of taxation should be limited to persons, property, and business exclusively within the territorial jurisdiction of the taxing power.* It would seem to be in the nature of a self-evident proposition, although in fact it is by no means so regarded, that the power of every state or government to tax must be exclusively limited to subjects within its territory and legal jurisdiction. "*All subjects,*" says Chief-Justice Marshall, in giving the opinion of the Supreme Court in the case of McCullough *vs.* Maryland (4 Wheaton, 431), "*over which the sovereign power of the state extends are objects of taxation; but those over which it does not extend are, on the soundest principles, exempt from taxation.*" And again, "the sovereign power of the state extends to everything *which exists by its own authority* or *is introduced by its permission.*" "Every nation," says Wheaton, "possesses and exercises exclusive sovereignty and jurisdiction throughout the full extent of its territory. It follows, from this principle, that the laws of every state control, of right, all the real and personal property within its territory. The second general principle is, that no state can, by its laws, directly affect, bind, or regulate property beyond its own territory. This is a consequence of the first general principle; a different system, which would recognize in each state the power of regulating persons or things beyond its territory, would exclude the equality of rights among different states, and the exclusive sovereignty which belongs to each of them." (Wheaton's International Law, chap. ii, § 2; Fœlix International Prisé, §§ 9 and 10.) And in a decision of more recent date (State Tax on Foreign-held Bonds, 15 Wallace, 306, 328), the United States Supreme Court said: "The power of taxation, however vast in its character and searching in its extent, is necessarily limited to subjects *within the jurisdiction of the state. Property lying beyond the jurisdiction of the state is not a subject upon which her taxing power can be legitimately exercised.* Indeed, it would seem that no adjudication should be necessary to establish so obvious a proposition."

The principle under consideration has also been made the subject of adjudication by the United States Supreme Court in a case of historic as well as of legal and economic interest. In September, 1814, the country being then at war with Great Britain, the town of Castine, in Maine, was captured by the British forces, and remained in their exclusive possession until after the ratification of peace in 1815. During this period the British Government exercised all civil and military authority over the place, established a custom house and allowed merchandise to be imported, some of which remained in Castine after it was evacuated by the enemy. On the re-establishment of the authority of the United States, the American collector of customs for the district, claiming a right on the part of the United States to Federal duties on the goods in question, demanded payment of the same from the owners or importers; and, the claim being resisted, the case went up to the United States Supreme Court, which with complete unanimity gave judgment, through Justice Story, for the owners or importers in the following language:

"We are all of the opinion that the claim for duties can not be sustained. By the conquest and military occupation of Castine, the enemy acquired that firm possession which enabled him to exercise the fullest rights of sovereignty over that place. The sovereignty of the United States was suspended, and its laws could no longer be enforced there, or be obligatory on the inhabitants who remained there and submitted to the conquerors. By the surrender the inhabitants passed under a temporary allegiance to the British Government, and were bound by such laws and such only as it chose to impose. From the nature of the case, no other laws could be obligatory on them; *for where there is no protection or allegiance, or sovereignty, there can be no claim to obedience.*"

Taxes, therefore, are necessarily the creation of each state, and no self-respecting Government ever permits any other Government to interfere with its tax laws or their execution, and a toleration of such interference in any degree presupposes dependence, subjection, or absence of independence. An obvious co-relation of this proposition, and also a matter of fact, is that a violation of the tax or revenue laws of one country has never been regarded as an offense or crime in any other country; and the English courts have held that contracts to evade the customs laws of a foreign country are not illegal. Hence, also, offenders in this respect are never taken into account in extradition treaties between different nations and their governments. Some years ago a United States district attorney in New York procured through the Department of State at Washington the extradition of a person from England on the charge of forgery. On his arraignment before a United States court it transpired that the offense committed was the manufacture and use of fraudulent invoices, to which forged or fictitious names had been attached, for the purpose of evading the payment of United States customs or taxes on certain imports; and that the intent of the prosecution was punishment, not for forgery in the ordinary sense of the term, but for smuggling, for which latter offense there was no precedent that extradition had ever been granted by any country. The attention of the British Government having been called to the case, a request was preferred by it to the authorities in Washington that the trial of the accused should be discontinued, on the ground that a fugitive from justice, when surrendered by a country in which he had sought refuge, should not be tried for any offense other than the one specified in the extradition demand, and for which extradition was granted. Compliance with the request being refused, although as a matter of fact the trial was discontinued, the British Government took occasion, when extradition was next demanded of her by the United States—which happened to be the case of a former well-known citizen of Boston who had committed forgery in the sense that constitutes a crime in all countries—to refuse it, although the offender had in the first instance been arrested in England and was in custody; and for many years subsequent and for reasons above given there was no extradition in force between the United States and Great Britain and her colonies, with the result of making Canada an *Alsatia*, or place of safe refuge, for all criminals of the former country.

All, therefore, that any government can legitimately ask of another government in respect to taxation is, that its subjects or citizens residing in such foreign state shall not be there discriminated against because they are foreigners; but shall be treated in exactly the same manner as the subjects or citizens of the taxing power and their property are treated—no better and no worse. If foreigners feel aggrieved, they must first exhaust all the remedies against unjust taxation provided by the institutions of the taxing country; as foreign importers, for example, aggrieved by rulings or appraisements at the custom houses of any country, must first appeal for redress to the courts of such country. A recent event of great economic and legal importance is also worthy of narration and consideration in this connection.

A board of appraisers and assessors charged with the duty of assessing, for the purpose of taxation, the property in Ohio of telegraph, telephone, and express companies, discharged the duties incumbent upon it—taking an express company for example—in the following manner: *First*, by determining the value and liability to taxation of the real estate of the company situated in Ohio; *second*, the personal property, including moneys and credits, owned by the company in Ohio, and the value thereof; *third*, the gross receipts during the taxing year of the company in Ohio, from whatever sources derived. It was conceded that the returns made by the company to the above officials were correct, and that the aggregate value of the items included in such returns liable to taxation in 1895—the same as other like property in the State—was $42,065. The board of appraisers and assessors added, however, to this amount the sum of $491,030, making the aggregate of the tax liability of the express company $533,095; and based their action not on any belief or pretense that any considerable amount of real or personal property within the territorial jurisdiction of the State had been discovered which had hitherto escaped taxation, but that sources of reported value which were entirely outside of the territory and beyond the jurisdiction of the State of Ohio—when they constituted a part of the value of the capital or franchise of a corporation located and established in some other State for the purpose of carrying on business, and that business "interstate commerce" entirely within the control of the Federal Government—might be added to the intrinsic value of property within the State; thereby assessing not only property *within* the State of Ohio, but a proportion also of all property situated *without* its territorial boundaries. The question involved was therefore the constitutionality of extra-territorial taxation; and the case, after consideration by State and United States Circuit Courts, was finally brought before the United States Supreme Court. Here, notwithstanding the citation of numerous former opinions and judgments of the court wholly adverse to the constitutionality of the principle on which was based the assumption and action of the State of Ohio, the court by a majority of one held to a contrary view; and gave judgment in support of the State assessments on the express company. It is clear, therefore, that the State of Ohio has been justified, for the time being, in an attempt to tax something that it calls property, but which is neither tangible nor visible; that has no intrinsic or essentially inherent value; and which procedure, if generally accepted and put in practice by other States, would antagonize all formerly accepted theories and legal decisions in respect to extra-territorial taxation, and ultimately destroy all interstate commerce between the several States of the Federal Union.

AN IMPLIED BUT FUNDAMENTAL RECIPROCAL OF TAXATION. —Notwithstanding the absence of any warrant for assuming that there was ever any real or implied contract, whereby a State in its beginning or development agreed to give a certain amount of protection to life and property in return for an equivalent in money, goods, or services of its citizens—an assumption which has been characterized as the "commercial theory of taxation"*—

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* "The right of a state to take the citizen's property must be put on higher ground if it is to stand on perfectly safe ground. Of course, such higher ground is not to be found

it is nevertheless true that the "co-relative" or "reciprocal" of taxation is protection; or, in other words, according to the political theory of our governments, national and State, and in fact of every government claiming the title to be *free*, taxes may be legitimately assumed to be the compensation which persons and property pay the State for protection. This assumption, it is believed, has been indorsed and accepted by every writer of repute on economic subjects who has discussed taxation from the time of Montesquieu down to a very recent period;* and in the repeated instances in which this matter has come before the courts for adjudication, the highest judicial authorities have uniformly given judgment or expressed opinions to the same effect. In confirmation of these statements the following citations are submitted:

"Where there is no protection," said Judge Story (in the case of the United States *vs.* Rice, 4 Wheaton, 276), "there can be no claim to allegiance or obedience." Again the same eminent authority (in the case of Miles *vs.* Duryea, Cranch, 481) thus strongly expresses himself: "It is an eternal principle of justice that jurisdiction can not be justly exercised by a State over property that is not within reach of its process—that is, property which it can not protect."

"*Taxes are a portion which each individual gives of his prop-*

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in the pretense that the right in question is the simple right of might; that the ruling power, whether monarch or majority, is physically able to take and apply as it chooses all that the individuals ruled over called their own; and that because it can, it morally may, take whatever part it thinks fit. With simple ethics the leviers of taxes, whenever they are a distinct class, are wont to content themselves. But whatever countenance they have received from such moral philosophers as venerate successful force, the principle will hardly serve those who study the matter as taxpayers."—*Theodore Bacon.*

* "The philosophy of our plan of voluntary political association is, that all individuals, and all the values within a community, shall aggregate into one mass all the power which they separately contain, which sum total shall constitute a sovereignty of the whole. This sovereignty—the soul of the State, which can not be impaired and the State survive—reflects back upon its constituents, in detail, all that it has received from them. What it receives, and what it returns, is of two kinds, as to both source and object, viz., individual service *to* the Government, and protection to the individual *from* it. Thus, in his individual capacity, a man is bound to perform military service, and the State, by the military arm, is bound to protect him from invasion. He is bound to do jury duty, and the authorities are bound, upon his demand, to provide him a jury. He is bound to aid the sheriff, and the sheriff is bound to execute process in his favor by *posse comitatus*, if necessary. These personal services correspond to those which in feudal times the mesne lord, holding a frank tenement, owed the lord paramount. They can not be compounded for, for their value consists in their being rendered in kind. *Their performance is the only price which the citizen pays for his citizenship.* The terms are not only consistent and harmonious with our general scheme of government, but are highly politic. To all political privileges we admit each one by virtue of his being a man, free born, and of lawful age; we ask him nothing concerning his property, unless his property asks something from us."—*Lowrey, Argument, New York Assembly, 1862.*

erty, in order to secure and have the perfect enjoyment of the remainder. Governments are established for the protection of persons and property within the limits of the state, *and taxes are levied to enable the government to afford and give such protection.* They are the price and consideration of the protection afforded." (Ingersol, J., Circuit Court of the United States, Duer *vs.* Small.)

"There is nothing poetic about tax laws. *When they find property, they claim a contribution for its protection.*" (Lowrie, Chief Justice, Tinley *vs.* The City, etc., 32 Penn., 381.)

Montesquieu, writing with the monarchical institutions of France mainly or solely in view, discusses this subject in his Spirit of Laws (book xxxi, chap. i), as follows: "The public revenues are a portion that each subject gives of his property, *in order to secure or enjoy the remainder.*"

"The right to tax an individual results from the general protection afforded to himself and his property."—*Vattel, Law of Nations, book i, chap. xx.*

"Property and law (i. e., government or the state) are born together and die together. Before laws were made, there was no property; take away laws, and property ceases."—*Bentham, Theory of Legislation.*

The principle here involved is also clearly and succinctly further expressed in the following citations:

> "Taxation" is, in any view, taking private property for public use, and it can not be so taken without an equivalent, both as to the Government or the citizens. It is not competent to convert private property to public use by way of taxation, and without compensation, any more than by any other mode.
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> Taxation (if anything in the nature of principle is assumed as its basis) therefore implies that the government imposing it will return an equivalent. But to return an equivalent in the form that was taken, namely, money, would be stultification. The only equivalent that a government can return, and the only one, in truth, that justifies taxation, is in the nature of a guarantee that the person, property, or business on which the tax is imposed shall have all the rights which the civilization of the state represents, or, in other words, "protection."—*Redfield.*
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> "If it were practicable to do so," says Justice Cooley, "the taxes levied by any government ought to be apportioned among the people according to the benefit which each receives from the protection the government affords him. This is upon the assumption, never wholly true in point of fact, but sufficiently near the truth for the practical operations of government, that the benefit received from the government is in proportion to the property held or the revenues enjoyed under its protection."—*Cooley, On Taxation, pp. 14-17.*

Notwithstanding this preponderance of opinion, argument, and legal decisions in favor of the correlation of taxation and protection, the truth of this assumption has been called in question in recent years, and even wholly denied by some economic and legal authorities. Thus, in most of the States of the Federal Union (but not in other countries), sovereignty in respect to taxation is assumed, or enacted to embrace "goods, chattels, money, and effects, *wherever they are;* ships, public stocks and securities, stocks in turnpikes, bridges, and moneyed corporations, *within or without the State*"; and where the administrators of the law tax *residents* for personal property, even of a visible, tangible character, having a *situs* in another State or country; and, by another irreconcilable rule, tax *non-residents* for all of their personal property having a *situs* within the State. (Massachusetts Statutes.)

Such antagonism would seem to be wholly due to an inadequate comprehension of the subject. It is assumed, for example, that there can be no necessary reciprocity of the nature indicated between the State and the subjects of taxation, because, in the case of subjects—persons, property, and business—upon which no tax is levied, there can be no correlation, and therefore no claim whatever for protection; and in illustration and support of this proposition it is pointed out that churches and other public institutions, specifically exempt from taxation, need and receive as much protection from the State as structures used for dwellings and stores, and that tramps, who have nothing to pay with, are equally entitled to invoke and use the power of the State for protection as those who are taxed for millions. "So also the business that is not taxed at all, it is said, can no more be plundered with impunity than that which is taxed the heaviest." * The error in all this reasoning is fundamental, and arises from a failure to comprehend that in every civilized state every person or thing is taxed, either directly or indirectly, by the diffusion of taxes, and that it is not possible to name anything in such a state that is exempt from taxation; that the primary purpose for which the state exists is to afford protection to persons and property; that it—the state—practically ceases to exist when it is unwilling or unable to afford such protection; and that, even if willing, it could not protect, except through the ability that comes to it through the possession of the power and the exercise of taxation.

Fourth. *Taxes should be reasonable, regular, and not arbitrary as respects method, time, and place of assessment and payment, and, above all, proportional.*

The justice and the necessity of these conditions as essentials of a true system of taxation ought to command universal assent without argument. Adam Smith held to the opinion, "founded," as he says, "on the experience of all nations, that the certainty of what each individual ought to pay is, in taxation, of so great importance that a very considerable degree of inequality is not near so great an evil as a small degree of uncertainty." The evil of uncertainty does not, however, often characterize the tax systems of the United States, except in the case of taxation by the Federal Government of imports, when rates (customs) are sometimes held for considerable periods in abeyance by reason of political antagonisms of legislators. One of the most remarkable example of this occurred during the months from December, 1893, to August, 1894, when the uncertainty as to the prospective rates on imported merchandise occasioned great stagnation of business in the United States, with inevitable great contingent losses. Another even more striking illustration of the evils of uncertainty in taxation is to be found in the recent (1897) proposition to subject merchandise, imported in strict conformity with established laws and rates at the time of importation, to the retroactive incidence of increased taxes, not certain but prospective in respect to rates, and not enacted or embodied in the form of statute laws. Such action is in the nature of an arbitrary fine or penalty, and not taxation, and probably does not find a parallel in the history of any civilized nation, and would not now be tolerated in any of the most despotic governments of Europe.

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* The claim or argument in defense of extra-territorial taxation will be more fully considered hereafter.

The term *proportional*, which is largely used in constitutional provisions and in statutes relating to taxation, has, however, a meaning so much broader and of such greater significance than is generally attributed to it by law-makers and even law interpreters, that it is worth while to institute an inquiry and endeavor to understand clearly what it does mean. Scientifically considered, it means *the making of the burden of taxation equal upon all subjects of immediate competition*. This principle is one of the prime essentials of taxation, and when it is violated the act of taking, or the enforced contribution, is not entitled to be considered taxation, but becomes at once an arbitrary spoliation or confiscation. Thus, to illustrate: Suppose it were proposed to tax the stock in trade of red-haired men five per cent, and those of red-nosed men ten per cent; or, as was provided in the income-tax law enacted by the Congress of the United States of 1894, which exempted incomes below four thousand dollars per annum from taxation and taxed all above that sum two per cent; or to do as actually once was done in England, under an income-tax law enacted in 1691, tax Catholics at rates double those imposed on Protestants; it seems clear that such transactions could not involve any principle or be regarded in any other light than the mere arbitrary and despotic exercise of power; or the making of the possession of a red nose or red hair, or the result of enterprise, skill, economy, or the fortuitous circumstance of birth or belief, the occasion for inflicting a penalty. Yet this was what substantially was done in the middle ages, when nobles were exempt from taxation because they were nobles, and the common people were taxed because they were villains or bondmen; when Jews were assessed because they were not Christians, and Catholics because they were not Protestants.

It would seem to be clear, therefore, that a tax that is not levied proportionally or, what is the same thing, equally and uniformly upon all subjects *in the same field of competition*—as, for example, upon all persons engaged in the same business or profession, or upon all property of the same kind and all profit or income (less exemptions in the nature of charities) in the same ratio—is a discriminating exaction, without claim to either justice .or equality, inasmuch as to the same extent that some are favored by the discrimination others are inevitably plundered or crushed. It is also well to remember that when the term "uniformity" in respect to taxation is used, as it often is, in the place of "proportionality," the meaning is essentially the same; and that uniformity of taxation does not consist in the payment of the same amount by each taxpayer, but that the proportion of the value of each particular class or subject which each person pays in taxation to the state shall be everywhere the same.

In the soundings which have been made at great depths in the ocean for telegraphic or other purposes, the sounding line has not infrequently brought up from the bottom small chambered shells or other minute animals of exquisite organization and structure; and the question naturally arises, How can these minute organisms live and flourish under the enormous pressure that in some instances must be exerted upon them of at least three tons to the square inch? The explanation is to be found in the circumstance that the pressure is everywhere equalized, being as much from within outward as from without inward, and thus an equilibrium is maintained, under which development goes on and existence is made possible; and it is in preserving this equilibrium, this equalization of pressure, that constitutes the very essence of correct taxation.*

Another point worthy of attention in connection with this subject is, that forms of taxation which were not authorized with any purpose of making them unequal in their incidence or burden, not infrequently (as is especially the case in the United States) become so by reason of extraneous circumstance; inasmuch as every tax which popular sentiment, year after year, will not allow to be equally enforced, is, to the extent that it is enforced, a discriminating tax of the most unjust and unequal character. Under the internal revenue laws of the United States as they existed not many years ago, there was a very striking example of this character in the case of the tax on matches, to which more particular reference will be made hereafter, and one worthy of notice still exists, in the case of the tax on negotiable securities (or instruments)—as railroad and other corporate bonds—which the laws of every State in the Federal Union make subject to taxation; inasmuch as it is notorious that such taxes are not paid by the great majority of the citizens who own such securities, but are paid as a rule by guardians, trustees, and executors, who are obliged to inventory them in probate offices; with the result that widows, orphans, and minors are plundered and crushed; while those who evade the tax, through the utter inability of the State to collect it, are rewarded for their evasion in an increased rate of interest. Uniformity or proportionality in taxation is, therefore, one of the fundamental principles of every free and just government; and the safety of all tax-payers against the grossest abuses demands that in taxing any class or locality the principle of equality of rate should be kept sacred and inviolate.

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* Speech of Mr. Lowe, Chancellor of the British Exchequer, afterward Lord Sherbrooke.

The Constitution of the United States requires that "all duties, imposts, and excises shall be uniform throughout the United States"; and the question as to what constitutes uniformity of taxation under this provision has repeatedly come before the courts — Federal and State — for the purpose of definition, and so has become invested with a degree of historical interest. A natural inference, at first thought, would be, that under this provision of the Federal Constitution all property subject to taxation must necessarily be taxed at the same rate or ratio—that is, if horses, wagons, and land are taxed, then the same per cent of value must be assessed upon the horses and wagons as upon the land; and if some eight hundred per cent is assessed upon distilled spirits—whisky—(as is the case in the United States at the present time) every other commodity from which it was proposed to raise revenue ought to be taxed in the same proportion. In like manner under the customs, all imports—liquors and pig iron, for example—would have to be subjected to one rate of duty. This difficulty, so far as the Federal Government is concerned, has been obviated by an assumption, which the courts have sustained, that a tax "is uniform within the meaning of the constitutional requirement if it is made to bear the same percentage over all the United States"—that is, it must be uniform as regards any particular article in all places; that whisky or any other commodity, for example, shall not be subjected *to Federal taxation* at one rate in one State and at a different rate in another State, but that different articles may be subjected to different rates, provided they are uniform as between different places and different States; as it obviously "could not have been the intent of the framers of the Constitution that the Government in raising its revenues should not be allowed to discriminate in respect to articles which it desired to tax."*

In the case of the several States of the Federal Union, to which the Federal constitutional requirement in respect to uniformity of taxation does not apply, the same question—i. e., as to what constitutes uniformity—has been also a troublesome one, but different in its manifestation. The provisions relating to taxation in the Constitutions of these several States generally start with the idea, expressed or implied, that taxes must be uniform; and a strict construction of this language in a tax statute, operative in only one State, and where the Federal limitation of *uniformity* as respects place does not apply, might be construed as restraining the authorities of a State from imposing any different rate of taxation on the manufacture or sale of liquors and the manufacture and sale of other merchandise, or on the land and the business of the agriculturist. These difficulties in the way of construction have, however, been largely obviated by recognizing that when in the statute of a State the words "taxes must be uniform" are used, the word "uniform" does not mean, as in the Federal Constitution, uniformity as to "place," but uniformity "with regard to the subject of the tax"; an interpretation in full conformity with the principle before enunciated, that uniformity of taxation consists in the making of the burden of taxation equal upon all subjects which are in the same field or sphere of competition; or, as has been also expressed by Justice (S. F.) Miller, "different articles may be taxed at different amounts, provided the rate is uniform on the same class everywhere, with all people and at all times. Take, for instance, the case of a license: if everybody in any particular class is required to pay a certain license—if all lawyers are taxed twenty-five dollars a year, all merchants one hundred dollars, and all saloonkeepers two hundred dollars—then the license taxation is uniform, because it imposes the same burdens upon every man of the same class, who comes within a circle of well-defined limits. . . . This interpretation," he adds, "may be a little strained, but probably it has arisen from the necessity of enabling the Legislatures to levy taxes according to common sense, if not altogether with regard to strict uniformity." †

The opinions expressed by the State courts of the United States when this question of uniformity of taxation has been practically brought before them, is indicated by reference to the following decisions:

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* Lectures on the Constitution of the United States, Justice Miller, pp. 240, 241.

† Miller (Justice S. F.), ibid.

The Constitution of the State of Pennsylvania provides (Article IX, section 1) that "all taxes shall be uniform upon the same class of subjects within the territorial limits of the authority levying the tax, and shall be levied and collected under general laws." In June, 1885, an act was passed by the Legislature imposing a tax of three mills on the dollar on mortgages, moneys loaned or invested in other States, money capital in the hands of individual citizens, and other classes of property. The act did not extend to corporations, which were taxed at a similar, in some cases at a higher rate, under a statute of 1879. The act of 1885 was opposed on the ground that it violated the constitutional rule of uniformity, but it was declared valid by the Supreme Court of the State, which held that substantial uniformity had been obtained.

A decision in New Jersey turned upon a constitutional provision that "property shall be assessed for taxes under general laws and by uniform rules, according to its true value." In 1884 the Legislature of the State passed an "act for the taxation of railroads and canals," which imposed a tax upon the lands and tangible property used by railroad and canal companies and their franchises, and touching no other property. The constitutionality of this law was questioned by most of the leading companies, but was affirmed by the State Court of Errors and Appeals, which held that as the law was a general one, framed in general terms and restricted to no locality, it operated equally upon a whole class of property, whose characteristics enabled it to be dealt with separately. The court further declared, that as a previous act had secured the companies against being required to pay more than their full share of tax, a substantial uniformity was thus secured.

These and other like decisions of the State courts of the United States show that in order to sustain a tax law under the requirement of generality or uniformity it is not necessary that all property should be taxed, and that a State has the right to select property for taxation at its discretion. Of course, discrimination may result from the exercise by the State of the power of dividing the objects of taxation into classes, but while persons of the same class and property of the same kind are subjected to an equal burden, the constitutional requirements as to uniformity seem to be satisfied.

The fourteenth amendment of the Constitution of the United States, which prohibits any State from depriving any person of property "without due process of law," is also in conformity with the principle enunciated in the above citations; for taxation without jurisdiction, and therefore without the possibility of the correlative return of any protection as compensation, would obviously be an arbitrary exaction and not due process of law. But if property is otherwise (than by taxation) taken by the Government (as by the so-called law of "eminent domain"), full and fair pecuniary return must be made for its value. This is a principle as old at least as constitutional government, and is so important that it is incorporated in the fundamental law of every State in the Federal Union. Article V of the Constitution of the United States also provides that private property shall not be taken for public use without due compensation. It is clear, therefore, that there must be a line between the taking of private property for public use by the law of eminent domain and by taxation. But how can that line be drawn except by the rule that rightful taxation means uniformity of burden on competing vocations and competing property? The following decision by the Supreme Court of New Jersey is clearly in conformity with this conclusion: "A tax," it said, "upon the persons or property of A, B, and C individually, whether designated by name or in any other way, which is in excess of an equal apportionment among the persons or property of the class of persons or kind of property subject to taxation, is, to the extent of such excess, the taking of private property for a public use without compensation. The process is one of confiscation and not taxation." (Township Committee of Reading, 35 N. J., p. 66, 1872.)

Fifth. *Taxation should not be employed as an agency or for the purpose of enforcing morality, or as an instrumentality for correction or punishment.*

The punitive or moral idea has probably always entered to some extent as an element in all those taxes which have been levied on luxuries, and more especially on all those forms of luxury which are regarded as frivolous or as mere insignia of wealth and title, such as hair powder, wigs, coats of arms, carriages, etc. But when a government assumes to inquire what are the articles the consumption of which is prejudicial to the interests and well-being of its people, and then embodies the results of such inquiries into its measures of revenue; so that while providing means for the support of the state it also prescribes how the citizen ought to live, dress, eat, or drink, the result is always ineffectual for purposes of revenue, and far more so for the promotion of morality. Examples illustrative and confirmatory of these conclusions are so numerous as to make a selection of them not a little difficult. The following have been cited by the late Sir Morton Peto: "A tax on dice in Great Britain, repealed in 1862, had the ludicrous result of producing for many years a revenue of five shillings per annum from a license of thirty to forty pounds a year on the business of manufacturing them. Another provision of law was that every person having dice unstamped by the revenue officials in his possession was liable to the penalty of five pounds for each pair! But stamped dice could not be obtained. Every one who wanted dice, even cabinet ministers and revenue officials, purchased square pieces of ivory for a few pence and marked them for themselves. As regards packs of cards, the regulations imposed by a number of complicated acts of Parliament were so stringent that legally cards could scarcely be made or sold. Nevertheless for many years cards were hawked about the streets unstamped and without a license; and the manufacture of cards for exportation was so flourishing that nearly half a million packs were estimated to be surreptitiously made for exportation at the time the obnoxious taxes were repealed."

Sixth. *No tax should be levied the character and extent of which offer, as human nature is generally constituted, a greater inducement to the taxpayer to evade rather than pay.*

The justification and wisdom of the above maxim find support in a lesser degree from argument than from experience, although the deductions from abstract reasoning ought alone to constitute its sufficient indorsement. It has been pointed out by Herbert Spencer that ideal men are possible only in an ideal state; and, conversely, that a perfect social state is possible only when every unit has achieved perfection. As this condition has not been attained, and until the "millennium" arrives is not likely to be, the inference is legitimate that a large proportion of mankind are not "decently honest," inasmuch as in every variety of business where opportunity for the perpetration of fraud exists, much labor is expended in guarding against dishonesty. This is specially exemplified in the case of railroads, "where tickets have to be dated, punched, and carefully collected to prevent their being used again by the masses."

But it is in matters of taxation that the largest amount of irrefutable evidence is to be found in support of the above maxim. Thus in the case of smuggling or the evasion of duties on imports, the experience of all governments and of almost all countries is to the effect, that when sufficient inducement in the way of gain from a violation of the law is offered, such statute can not be executed even when penalties as severe as death have been made contingent on individual arrest and conviction. But it has been reserved for that nation whose people claim to be the most law-abiding and intelligent, to furnish the most confirmatory evidence on this subject—namely, the United States—the Congress of which in 1865 imposed a tax on distilled spirits amounting to more than fifteen hundred per cent on the then average prime cost of production. The result was, that the Government was only able in 1868 to collect the tax on less than seven million gallons out of an annual product of certainly not less than fifty million gallons; which last, sold as it undoubtedly was at the current market price (tax included), left to the credit of popular corruption at least $80,000,000.

The United States is confessedly one of the most powerful of nations and governments, but its entire military force can not crush the illicit traffic in refined opium, under a temptation of the realization of six dollars contingent on every pound of this commodity that is successfully smuggled into the country.

THE BUBONIC PLAGUE.

By VICTOR C. VAUGHAN,
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THOSE twin monsters of human misery, Famine and Disease, are now holding high carnival in India. Death follows in their wake and gathers in a rich harvest. Appeals to the charitable of the world are being made, and the civilized nations of Europe and America are looking apprehensively toward the East. The great plague, which has confined its ravages for the most part to certain limited districts of Asia for the past two hundred years, seems to have grown strong enough to threaten to take a journey abroad. The black death has unfurled its banner in the face of modern civilization. For a period of more than a thousand years this disease once held dominion over Europe. The story of the horrors of the fourteenth and seventeenth centuries has seemed a history of a past so remote that it has been nearly forgotten save by those especially interested in the progress of medicine. Is history to repeat itself in this form of human suffering? What is the bubonic plague? Do we know anything of its specific cause, of its methods of invasion, of the means necessary to combat it? These are questions which I have thought might at this time be of more than passing interest.

Oribasius was physician and friend of Julian the Apostate, and lived in the fourth century of our era. He wrote a medical encyclopædia, composed principally of extracts from older medical authors. This encyclopædia remained unknown in the Vatican Library until the early part of the present century, when it was discovered by that indefatigable student of old manuscripts, Cardinal Mai. In the forty-fourth book of this collection there is a note from Rufus, who states that the physicians of the time of Dionysius were acquainted with a disease which is described as "*Pestilentes bubones maxime letales et acuti, qui maxime circum Libyam et Egyptum et Syriam observantur.*" There follows a description of this disease sufficiently accurate to leave no doubt that it was identical with the bubonic plague. Now, this Dionysius lived about three hundred years before Christ. There is therefore no doubt that the plague has been known for more than two thousand years.

The next authentic account of the plague is that of the epidemic of the sixth century. The disease at this time was first recognized in Lower Egypt, from which country it extended into Europe by two routes. It was brought from the north coast of Africa, and it also extended through Palestine and Syria, and by this way into Europe. This disease became pandemic and spread, according to the chroniclers of the time, to the "ends of the habitable world." It prevailed in an active form for about sixty years, showing great virulence in certain localities. According to Warnefrid, "it depopulated towns, turned the country into a desert, and made the habitations of men to become the haunts of wild beasts." Hirsch says: "It is impossible to decide whether this outbreak of plague in the second half of the sixth century was the first general diffusion of the disease on European soil, or whether it had been epidemic there before, and if so, to what extent. What is certain is that this outbreak gave it firm hold in Europe, and that it kept its dominion there for more than a thousand years."

It is an interesting fact that this pandemic occurred during the reign of Justinian the Great, the most illustrious emperor of the Eastern Roman Empire. This man, who did so great a service to the world in the codification of the Roman laws, seems to have been both wise and unwise. He is said to have been so filled with Christian ardor that he forcibly baptized more than seventy thousand pagans in Asia Minor alone; and yet he was a pagan by birth, and there is reason for believing that he died a pagan. He is known as the great legislator, and yet he oppressed the people to the verge of starvation by the imposition of unjust taxation, and by granting monopolistic privileges to a few. On one side he instituted just reforms and on the other he fell into reckless and extravagant expenditures. He built the great cathedral of St. Sophia, now a Turkish mosque and one of the architectural wonders of the world, with a treasury filled with the sighs and tears of his overtaxed subjects. I mention these facts in order to show that the spread of the plague occurred at a time when the masses of the people were oppressed by wrong and broken by burdens too heavy to carry.

From the time of Justinian on, for more than ten centuries, as has been stated, the plague raged, sometimes with more, sometimes with less, severity, in Europe. The historians of the time generally content themselves with a statement of its most violent outbursts and an enumeration of its victims. The numbers given must, in many instances at least, be gross exaggerations. It is possible, also, that other diseases, especially smallpox, were included in these accounts, but, as Hirsch states, the bubonic plague takes at any rate a foremost place among the great epidemic diseases of those times.

The same author says: "There is only one of the epidemics of the plague in the middle ages that has arrested the attention of the chroniclers, poets, and physicians of those days; and that interest was awakened by the enormous diffusion that it reached over the whole of the then known world, by its victims reckoned in millions, and by the shock to the framework of society which it brought with it and left behind it. This disastrous pestilence, known everywhere under the name of black death, as one of the great events of the world's history, has fixed the attention of writers in a high degree, and has been thought worthy to be painted in minutest details and in the most vivid colors."

Several accounts of the plague of the fourteenth century have become classical. Among them I may mention that of Boccaccio, which begins as follows: "In the year, then, of the fruitful nativity of our Lord, 1348, there happened at Florence, the fairest city in all Italy, a most terrible plague; which, whether owing to the influence of the planets, or that it was sent from God as a just punishment for our sins, had broken out some years before in the Levant"; and concludes thus: "Between March and July following it is supposed, and made pretty certain, that upward of a hundred thousand souls perished in the city only; whereas, before that calamity, it was not supposed to have contained so many inhabitants. What magnificent dwellings, what noble palaces were then depopulated to the last person! What families extinct! What riches and vast possessions left, and no known heir to inherit! What numbers of both sexes in the prime and vigor of youth, whom in the morning, neither Galen, Hippocrates, nor Æsculapius himself but would have declared in perfect health—after dining heartily with their friends here, have supped with their departed friends in the other world!"

This epidemic, like all others of the plague, spread from the East to the West. It prevailed in the Crimea in 1346, reached Constantinople in 1347, and, as we have seen by this quotation from Boccaccio, began its devastations in Florence in 1348, and by the beginning of 1350 it had spread all over the continent of Europe and the adjacent islands. Hecker places the number of deaths from this epidemic at no less than twenty-five millions, or about one fourth of the inhabitants of that part of the globe at the time. Hirsch believes that this estimate was not too high.

The history of the fifteenth century is dotted with notes of local epidemics, and at this time physicians begin to report more accurately and in greater detail the characteristic symptoms and the course of the disease. It was at this time that exanthematic typhus was recognized as a distinct disease, and distinguished from the other pests of the medical profession.

During the sixteenth and seventeenth centuries the bubonic plague seems to have prevailed as an endemic disease in Europe.

There was scarcely a year during these two centuries that this disease did not assume alarming proportions at some place on that continent. The last visitation in England is known as the Great Plague in London, which occurred in 1665. This has been very graphically described by De Foe, and has been the basis of the thrilling story by Ainsworth entitled Old St. Paul. During the last quarter of the seventeenth century the plague seems to have gradually receded toward the East.

During the eighteenth century it repeatedly threatened to extend over Europe, but seldom reached farther than Turkey and the immediately adjacent territory to the north. However, there were as many as eighteen distinct and severe epidemics in Constantinople during that time.

Up to 1841 the plague occasionally became epidemic in the Balkan Peninsula, and there was an outbreak in the province of Astrakhan in the winter of 1878–'79. Since the last-mentioned years it has not appeared in Europe, but has continued in certain parts of Asia. In 1894, just before the beginning of the Chinese-Japanese War, it appeared in a virulent form at Hong Kong. The Japanese Government sent Kitasato and the French sent Yersin to study this disease according to the latest methods of bacteriological research. Both of these men were eminently qualified for the work of their mission, and independently each soon succeeded in isolating the specific bacillus. It is found in the fæces, in the contents of the swollen glands, and in the blood. It consists of rods with rounded ends, which take stains more markedly at the extremities than in the middle. Sometimes the germ seems to be surrounded with a capsule. In beef tea it grows in chains and forms a viscid deposit on the walls and bottom of the tube. It also grows on blood-serum and agar. On potatoes it does not grow at ordinary temperature and only feebly at 38° C. It shows but little motility and grows most abundantly at the temperature of the body.

The bacillus is pathogenic to guinea pigs, rabbits, rats, and mice, and it is stated that at times of the existence of an epidemic of the plague some of these animals acquire the disease, and it has been suggested that they may act as agents in its spread. In the above-mentioned animals the first symptoms manifest themselves usually within from one to two days after inoculation. The animal becomes apathetic, the eyes are watery, the temperature rises, and death, preceded by convulsive movements, comes on within from two to five days. The tissue around the point of inoculation is inflamed and infiltrated with a bloody, gelatinous exudate. The spleen is enlarged and sometimes the lymphatic glands are swollen. The bacillus is found in the blood and in all the organs.

Mice and guinea pigs fed with pure cultures or with tissues containing the germs die with the symptoms mentioned above. Kitasato found the bacilli in a dead mouse from a plague-stricken house. He also inoculated animals with dust gathered from such houses, and one of these died with symptoms of the plague, and the bacillus was found in its body. In certain parts of Asia the disease is, according to Cantline, known as "rat plague," thus indicating an extensive infection of these animals.

Cantline makes the following statement concerning the susceptibility of rats to the disease: "On all hands rats are reported to behave peculiarly and with a wonderful constancy. Before, or it may be during an epidemic of plague, or before the individuals in any particular house in an infected locality are stricken, the rats leave their haunts and seek the interior of the house. They become careless of the presence of man, and run about in a dazed way with a peculiar limping jerk or spasm of their hind legs. They are frequently found on the bedroom floor or on the tables, but not infrequently their death is known by the putrefactive odor of their decomposition arising from beneath the flooring. So pertinent has this rat affection become, that during the epidemic in Macao in 1895 the Chinese and Portuguese left their houses when the diseased rats invaded their premises. The cause of the rats' behavior is undoubtedly disease, and the symptoms tally wonderfully with plague symptoms of man. Dr. Rennie examined them carefully in Canton, and noted the following postmortem appearances: (1) The stomach was distended and filled with particles of food, sand, and indigestible substances, and the mucous membrane was red and inflamed toward the pyloric end; (2) the liver was much enlarged and congested, and contained ova of tænia and distoma; (3) there was congestion at the base of the lung present in about forty per cent; and (4) glandular enlargement was present in thirty per cent of those examined. There is no doubt now that the disease in the rat and man is identical. The bacillus of plague has been met with in every case of rat disease of this description when it has been searched for. The infection of the rat is raised from being a mere popular belief into one of scientific precision, and we must now accept the rat, at any rate, as one animal liable to the plague. Whether the rat is affected previously to, coincidently with, or subsequently to man being attacked is open to question. Is the disease among rats a forerunner of its outbreak in man, and, if so, are they a means of infection? These are, of course, two separate questions."

Exposure of the bacillus in thin layers to the direct action of sunlight destroys it after from three to four hours, but to accomplish a like result from exposure to diffuse light as many days are necessary. The germ is killed by an exposure to a temperature of 80° C. for thirty minutes and at 100° C. within a few minutes. Spore formation has not been observed.

There is some reason for believing that there is a pseudobacillus of the plague as there is one of diphtheria. In his studies of the soil of the infected districts of Hong Kong, Yersin found a bacillus that resembled that obtained from persons with the disease, both morphologically and in its growth on culture media, but it was without effect upon mice and guinea pigs. He also observed great differences in virulence in the germs obtained from the sick; some of these were without effect upon the abovementioned animals. There were, moreover, observable variations in the size of the bacilli found in the bodies of the sick and dead.

The studies of Yersin and Kitasato were interrupted by the war between China and Japan, and a much more thorough knowledge of the bacillus and the disease caused by it will probably soon be in our possession.

I will now consider some of the characteristic symptoms of the disease. It is undoubtedly a septicemia, or form of blood-poisoning. As has been stated, the bacillus is found in the blood and in all the organs. It is customary to describe the disease under two forms. The milder epidemics are known under the name of *pestis minor*. In this form the glands of the groins and armpits swell and either suppurate or undergo resolution. There is moderate fever, although in exceptional cases the temperature may reach 104° F. The disease usually continues from ten to twenty days, and may last for from four to eight weeks. *Pestis minor* sometimes precedes and at other times follows the more severe forms of the disease. The former was the case in the epidemics in Mesopotamia in 1873 to 1878, and in Astrakhan in 1878.

Foderé, as quoted by Cantline, makes the following statement concerning *pestis minor:* "In the Levant and in the Marseilles epidemics of 1820, cases were to be seen which were not ushered in by any alarming symptoms, and where the natural functions were undisturbed, and where buboes and carbuncles appeared without fever, or only with slight fever, or the buboes went on to a healthy suppuration more or less prompt, or even disappeared and went on to resolution without the help of art, without any inconvenience, and with a perfect integrity of all the functions. This state is comparable to benign smallpox, during which children play together and walk in the streets without any precautions, no care being taken of their treatment, and yet terminating favorably. It is the benign plague of authors, which is observed when the disease commences and when it is at its end, though it is rarely seen in the middle period, which is entirely devastating, but it is not less plague, and it no less merits the attention of physicians and magistrates."

In *pestis major* there is a prodromal stage, accompanied by aching in the limbs, shivering, and a high degree of nervousness. The patient seems to be unable to quickly comprehend questions. There is a staggering gait similar to that of alcoholic intoxication. There is intense headache, with thirst and great pain in the epigastrium. The eyes become red; the tongue dry, swollen, fissured, and sometimes black, and at other times covered with a thick white coat. Coma may set in and death result before there is any marked elevation of temperature. In some cases, however, the temperature may reach 107° F. during the twenty-four hours preceding death.

In the cases less rapidly fatal there are glandular swellings. These occur in the groin in about fifty per cent of the cases, in the armpits in about thirty-five per cent, and less frequently in the neck and other localities. One peculiarity of the graver form of the disease is the occurrence of stablike pains in various portions of the body. This symptom gives rise to the superstition among the ignorant that the victim is wounded by invisible arrows shot from the bow of some demon. Suppuration of the buboes with free discharge has been regarded as a favorable symptom. The skin is sometimes covered with livid petechiæ, which become very dark after death. This condition gave rise to the term black death, which has been applied to certain epidemics. Large carbuncles may form in various parts of the body, and these are regarded as a very unfavorable sign.

A highly fatal form of the disease is accompanied by hæmorrhages from the lungs. This was a noticeable feature of the pandemic of the sixteenth century, and it was also observed in the recent outbreak along the Volga. Such hæmorrhages indicate a grave form of intoxication, and have been observed in the severer forms of other acute infectious diseases, such as smallpox.

The virulent form of the plague is often very rapid in its action, sometimes destroying life in a few hours, but the majority of fatal cases terminate about the fifth day. During an epidemic at Bagdad it was said that those who lived until the seventh day were safe, but, according to Colvill, four per cent of the fatal cases terminated after the tenth day.

The mortality from the plague in its virulent form is probably as great as or greater than any other of the acute infectious diseases. In many epidemics it may be more than ninety per cent.

Hecker gives the following statement, which must be an exaggeration, concerning the mortality of the black death: "Cairo lost daily, when the plague was raging with its greatest violence, from ten to fifteen thousand. In China more than thirteen millions are said to have died. India was depopulated. In Caramania and Cæsarea none were left alive. On the roads, in the camps, in the caravansaries, unburied bodies alone were seen. Twenty-two thousand persons and most of the animals were carried off in Gaza within six weeks. Cyprus lost almost all its inhabitants, and ships without crews were often seen in the Mediterranean, as afterward in the North Sea, driving about and spreading the plague wherever they went on shore. It was reported to Pope Clement that throughout the East, probably with the exception of China, 23,840,000 people had fallen victims to the plague."

Probably the most constant pathological lesion found after death from this disease is an enlargement of the lymphatic glands. The disease may run so rapid a course that the enlargement of the glands is not observable during life, but, according to recent and competent observers, changes in these tissues will be found in the great majority of cases. This has led Cantline who studied the disease at Hong Kong in 1894, to propose for it the appellation of "malignant polyadenitis." The same authority offers the following definition: "Plague or malignant polyadenitis is an acute febrile disease of an intensely fatal nature, characterized by inflammation of the lymphatic glands, marked cerebral and vascular disturbances, and by the presence of a specific bacillus."

Geographically the plague has been known as far east as the island of Formosa, where it now prevails; as far west as Ireland; as far north as Norway; and there is no definite information concerning its extension southward in Africa. It has never been known in the western hemisphere, but this is only due to the fact that up to the present time there has been no opportunity of its importation to this half of the world.

In this connection the following quotation from Hecker may be of interest: "The inhabitants of Iceland and Greenland found in the coldness of their inhospitable climate no protection against the southern enemy who had penetrated to them from happier countries. The plague caused great havoc among them. Nature made no allowance for their constant warfare with the elements and the parsimony with which she meted out to them the enjoyments of life. In Denmark and Norway, however, people were so occupied with their own misery that the accustomed voyages to Greenland ceased. Towering icebergs formed at the same time on the coast of east Greenland, in consequence of the general concussion of the earth's organism, and no mortal from that time forward has ever seen that shore or its inhabitants."

There is no known racial immunity to this disease. It is alike fatal to Mongolians, Africans, and Europeans. It has prevailed in the marshes along the Euphrates and on the Himalayas; in densely populated cities and in sparsely settled rural districts; on the sands of Egypt and amid the snows of Norway.

Climate and season have been studied in order to establish between them and the plague a causal relationship. Epidemics have followed prolonged droughts, and have prevailed during rainy seasons. The wind may blow where it listeth, but the bacillus heedeth it not. The epidemic at Hong Kong in 1894 appeared after a prolonged season of dry weather. Rain was anxiously looked for—probably prayed for. It was said, All will be well when the rain comes. At last the rain did come, and with it the disease seemed to be refreshed and the number of deaths was multiplied. The attempt to find in meteorological conditions a cause for our ills is a relic of the superstition of ages when it was believed that disease was sent from heaven to afflict man for his sins, and was due to the anger of the gods.

Overcrowding is undoubtedly a factor in the distribution of this disease, as it is of all other infectious diseases, simply because it renders transmission of the germ from one to the other more speedy and certain; but that the disease can be due to overcrowding is, in the present state of our knowledge, an absurdity.

Poverty and famine are factors in the propagation of the disease. Want of proper food renders the individual more susceptible. This has been demonstrated in case of more than one infectious disease by experiments upon the lower animals. Privation has always been associated with the most notable outbreaks of the plagues. As stated in the beginning of this paper, famine and disease are twin brothers, inseparable. Where one of them dwells there the other may be found. This is undoubtedly the reason why this disease has always found a home in the Levantine. Cantline says: "In the densely packed cities of Asia the poor exist forever on the fringe of destitution, and the least rise in the price of food brings scarcity, so that the term, 'the poor man's plague,' holds good for all time."

There has been much written concerning the period of incubation of this disease, but necessarily all is indefinite. Because a well man comes in contact with a sick one on a certain day, and manifests the first symptoms of the disease ten days later, does not prove that the period of incubation is ten days. The well man may have carried on his person the bacillus from the sick-room, and any time subsequent thereto it may have been introduced into the body. All that is said about the period of incubation of the infectious disease is based on the old theory—long since exploded —that the well man breathes in the miasm at the time of his coming into the presence of the sick one, while the truth is he may carry the germ under his finger nails or elsewhere about him, and there is no telling when it may first find its way into his body. We can determine the period of incubation in the lower animals by inoculation, and here we know that it varies greatly with the method of inoculation, the virulence of the germ, the number of germs introduced, and the susceptibility of the animal. All that may be said about the period of incubation in man is of but little value. The same is largely true concerning the extent to which the disease is contagious. In the epidemic of 1835 in Egypt only one of the French physicians who attended the sick contracted the disease. Bulard, who did not believe the plague contagious, wore for two days a shirt taken from the body of a dead man. He remained well, and thought that by this he had demonstrated the truth of his theory. Such experiments demonstrate nothing. There is no evidence that any of the bacilli were on the garment, or that, if they were, they were introduced into his body. During the epidemic in Hong Kong, fifteen European physicians and a number of Chinese medical students cared for the sick in the hospital, and none acquired the disease. This only shows that with care and cleanliness the sick may be attended without danger of infection of the attendants. Hundreds of bacteriologists in laboratories are daily handling the most virulent cultures of the diphtheria bacillus, and the first case of infection from this source has yet to be reported. This does not prove that these bacilli are not pathogenic to man, or that these men are insusceptible to the disease. Because an expert handles the most venomous serpents without being bitten, does not prove that the bite of these reptiles is harmless.

The exaggerated idea of the contagiousness of the plague held by some of the older writers is exemplified in a graphic way by the following quotation from Hecker: "Every spot which the sick had touched, their breath, their clothes, spread the contagion; and, as in all other places, the attendants and friends who were either blind to their danger or heroically despised it, fell a sacrifice to their sympathy. Even the eyes of the patient were considered as a source of contagion which had the power of acting at a distance, whether on account of their unwonted luster or the distortion which they always suffer in plague, or whether in conformity with an ancient notion, according to which the sight was considered as the bearer of demoniacal enchantment."

The plagues of the middle ages were undoubtedly spread by the processions of the Brotherhood of the Cross. These fanatics went, sometimes in great numbers, from place to place, praying for the sins of the world, and scourging themselves with leathern straps armed with points of iron.

The horrors of the plague of the fourteenth century have been depicted by Hecker and others. The moral depravity brought to light by this great epidemic is hardly credible. Many believed themselves poisoned, and suspicion fell upon the Jews, who have so often been treated by Christians with barbaric cruelty. Under the torture confessions were made, and then began the wholesale slaughter of the children of Abraham. In Basle, the whole Jewish population was brought together in a wooden building constructed for the purpose and burned. "At Strasburg two thousand Jews were burned alive in their own burial ground. . . . At Eslingen the whole Jewish community burned themselves in their synagogue; and mothers were often seen throwing their children on the pile to prevent their being baptized, and then precipitating themselves into the flames. . . . In all the countries on the Rhine these cruelties continued to be perpetrated during the succeeding months; and after quiet was in some degree restored, the people thought to render an acceptable service to God by taking the bricks of the destroyed dwellings and the tombstones of the Jews to repair churches and to erect belfries."

Knowing, as we now do, the specific cause of the plague, we may easily predicate the modes of its distribution. Anything that carries the bacillus may be an agent of its transmission from one person to another, or from one country to another. It is needless to dwell upon this point.

Is there danger of the plague being imported to this country? Yes, there is danger, but this being foreseen may be easily avoided. Thorough inspection of persons and disinfection of things from infected districts will keep the disease out of Europe and America. Only by the most gross carelessness could the plague be permitted to enter either of these continents. The method of disinfecting the mails from the Orient, as practiced by the English, is wholly inadequate, and the American authorities should redisinfect all such matter coming from the infected districts of India.

On the occasion of the opening of the Davy Faraday Research Laboratory at the Royal Institution, London, Dr. Ludwig Mond observed that if Great Britain had distinguished itself in one way more than another in that glorious rivalry with other nations for extending our knowledge of natural phenomena and our power over the forces of Nature, it had been by the large number of contributors to our knowledge who on the Continent would be called amateurs in science—men who devoted their lives to the study and advancement of science from pure love of the subject. He need only instance the names of Cavendish, Joule, and Darwin to say that they included men of the very highest rank.

HIGHWAY CONSTRUCTION IN MASSACHUSETTS.

By CHARLES LIVY WHITTLE, M. E.

IN the course of time there have been many changes in the method of transporting merchandise from town to town and from one country to another. Here, as in everything else, we see the gradual evolution of transportation, at first by man or beast, and finally by steam and electricity. Early man used himself as a beast of burden, and finally the ox and other animals were made to do service in his stead. With every improvement in method came a wider and wider range of trade and its consequent benefits. Efforts to improve the means of transportation resulted in the early invention of carriage by water. Hence we see the maritime peoples were the first to attain any considerable commercial prominence.

At the time this country was settled the lack of adequate means of moving commodities, excepting by water, led to the settlement of lands bordering the ocean, streams, and lakes, while equally good lands, not in close vicinity to water, offered but little attraction to the settler. Gradually the frontier was pushed farther westward; the narrow and obscure Indian trails were transformed into paths for horses and eventually became carriage roads. Before the railroad was devised public roads that possessed any claims to excellence were limited to the more populous States bordering the Atlantic coast. It is without doubt true that, had not transportation by rail been invented until the present time, the public roads of this country would be in a far more satisfactory condition than we find them to-day. With the advent of the locomotive came the withdrawal of active interest in the character of our highways. All the energies of our people were devoted to extending and perfecting the vast network of railroads that cross and recross the United States. Railway construction has now reached an equation of demand and supply, and we once again see the Commonwealths awakening to the importance of good roads, many communities vying with one another in their efforts to lead the States and earn a reputation for the excellent character of their highways.

The natural conservatism of the farming element of our people has been a difficult feature of the problem of arousing public interest in better roads to overcome in the past. The farmer has had but few object lessons in what a road should be. Adding to this the objections he has to an increase of taxation, we perceive the difficulties that stand in the way of educating the people up to the point of appreciating the numerous advantages that would accrue to them with a system of highways properly constructed and maintained. Little attention has been paid by the rural dweller to the arguments in favor of good roads. His line of reasoning is that roads that were satisfactory to his father and grandfather are good enough for him. In vain has he been told that, with good roads all the year round, the farmer and merchant come into closer communication; that he can sell his stock and grain when prices tempt him, instead of being dependent upon a favorable state of the road; that he can buy his supplies on rainy days, and increase his number of perishable crops, which are of uncertain value with bad roads, but become of certain value when impassable ways cease to cause spasmodic transportation.

To-day State roads are furnishing the farmer the much-needed object lessons—roads which by their general excellence throughout the year are causing, as in some counties in New Jersey, a marked increase in farm values. Other States, as Massachusetts, are building highways with State money, one fourth of which is eventually returned to the State by the county traversed by the way, while the legislative enactments of other States require a portion of the expense to be borne by the county in which the road lies, and by the freeholders whose property immediately abuts the improved roads. The mutual benefit derived from improved highways by all classes of people is now generally recognized in the more thrifty States, and from now on we may expect with surety the gradual development of our highways until the principal thoroughfares of the country come up to the required standard of excellence.

Travelers have described the celebrated Peruvian military road, leading from Cuzco to Quito, that was constructed long before the time the Spaniards conquered that country, about 1544. This road is variously estimated at fifteen hundred to two thousand miles in length, passing over deep cañons and across high mountain ranges. Large sandstone blocks formed the foundation, and this was covered with a native cement of a bituminous nature, forming a very smooth surface possessing great durability. Some portions of the road are still in an excellent state of preservation. The Romans also constructed over ten thousand miles of paved ways; but none of these ancient builders understood the principles made use of to-day.

The art of building the type of road known as the modern highway is not a new one. The second decade of this century in England witnessed the first examples of turnpikes constructed on scientific principles in that country as enunciated by Macadam. Like many discoveries, the first and one of the most important principles involved is one that we should expect would have been discovered and put in general practice long before 1816. At that

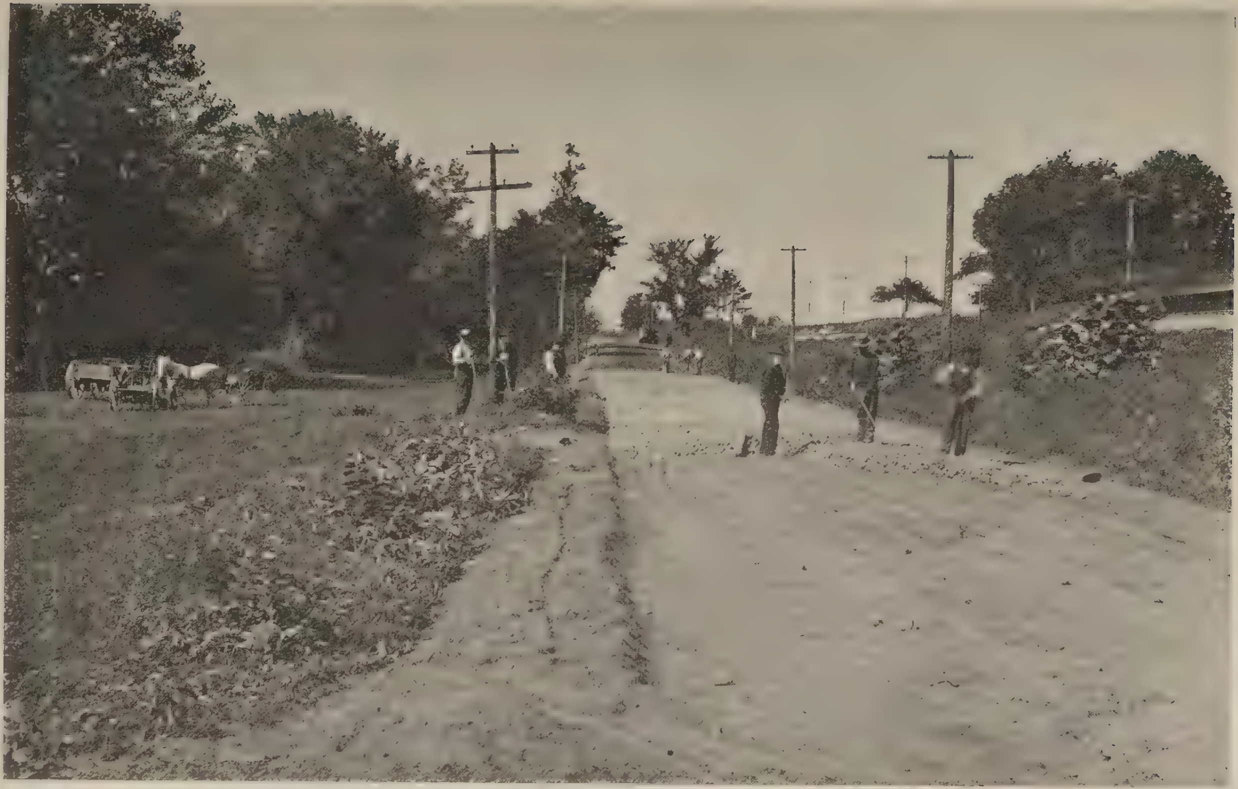

PLATE I.—STATE HIGHWAY, WESTFIELD, MASS. Showing subgrade rolled and first layer of broken stone in place.
(From photograph loaned by the Massachusetts Highway Commission.)

time it was the custom in Great Britain, as elsewhere, to build roads very largely of clay or gravel. Macadam observed that gravel never afforded a good, compact wearing surface until a large amount of traffic had passed over it, when it became hardened and cemented together. He sought an explanation of this phenomenon, and learned that when the pebbles were broken under the impact of heavy wheels they soon consolidated into a firm mass. Here was the great principle: angular stones solidify under pressure; rounded stones do not.* Amplifying this principle, he built up a complete system of road building which is in use to-day, as best shown in Switzerland and France, in England, and in other foreign countries, and is being revived so generally in this country at the present time, where the farmer is learning its advantages in the appreciation of land values, and where the bicyclist promotes the cause as the advance agent of good roads.

As defined by Macadam, a good road should be a hard, somewhat elastic surface to receive the wear of all kinds of traffic at every season of the year and during the greatest vicissitudes of weather, which shall also serve as a roof to that part of the road lying below. To use his own words, "A road ought to be considered as an artificial floor, forming a strong, smooth, solid surface, at once capable of carrying great weights, and over which carriages may pass without meeting any impediment." In order to realize such a surface it is necessary that the substructure of the road should be kept free from water, since, by the alternating freezing and thawing of the water, the wearing surface of the broken stone is disrupted, the water is offered a passageway through it, and the road becomes rough and difficult to travel.

It was the custom of Macadam, after the engineering work was completed and the subgrade established, to spread on a layer of stone to a depth of ten inches and to roll this surface with a heavy roller drawn by horses. These stones were broken by hand with small hammers, frequently a whole family working together, and were broken small enough to pass through a three-inch ring, or were not to have a maximum weight of over six ounces. A family of five people could break several tons per day. Side ditches were excavated where necessary, so that at no season of the year could water penetrate to the substructure of the road.

In 1816 Macadam began the construction and maintenance of one hundred and eighty miles of turnpike in Bristol District,

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* It is not improbable that Macadam was acquainted with the Napoleonic military roads constructed in France about 1775, which involved the principle of a thin layer of broken stone placed on a rock foundation. These roads were the invention of Tresaguet, a Frenchman, at about this time, and to him seems to be due the credit of first constructing what is now known essentially as the Telford system.

England.* A modification of this system was adopted by Thomas Telford about this time, which substituted a layer, or foundation, of irregular broken stone, set up on edge on the subgrade. Nine inches was the maximum dimension of these fragments. The rough surface thus made was smoothed down by going over it and breaking off the tops of the blocks with small hammers and packing the pieces thus obtained between the large blocks. This surface was then rolled as before. Telford built the celebrated Holyhead road, extending from Holyhead through North Wales to Shrewsbury—a road that served as a model at the board of inquiry appointed by Parliament in 1823. Each system had its partisans, and to-day the best features of both methods have been adopted under different conditions, dependent upon the character of the ground over which the road passes.

In 1892 the State of Massachusetts appointed a commission to investigate and report upon the character of the highways of the State, and to point out the trend that legislation should take in the matter of framing laws appropriating a yearly sum of money for the construction of State roads, and defining the powers of the Highway Commission to be appointed under the same act. This commission made its first report in 1893, and, on June 20, 1894, the Legislature appropriated the sum of three hundred thousand dollars for this purpose, to be used at the discretion of the Highway Commissioners the ensuing year. This commission appoints its own chief engineer, who has ultimate authority with the commission in the settlement of all questions that arise in connection with the work.

The laws enacted at this time do not place the initiation of State roads directly in the hands of the commission, but make the commissioners the tribunal to which all petitions made by towns, cities, or counties of the State are referred for action. It is a part of the policy of the commission not to allow a random construction of isolated stretches of road, but to make all ways constructed fit into a general scheme that shall have for its object a system of thoroughfares traversing the State that shall benefit the greatest number of municipalities and the State as a whole.

The method of procedure, as defined by the statute of 1894, is as follows: The selectmen of any town, the aldermen of any city, or the county commissioners must first file a petition with the Highway Commissioners, accompanied by a plan and profile of the road. Plans are then prepared by the chief engineer and submitted to the commission for its approval. It is a part of the set-

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* Although one of the earliest pieces of work on a large scale that was ever attempted, the report of the board of inquiry, referred to above, showed that similar roads had been built in Sweden previous to 1823.

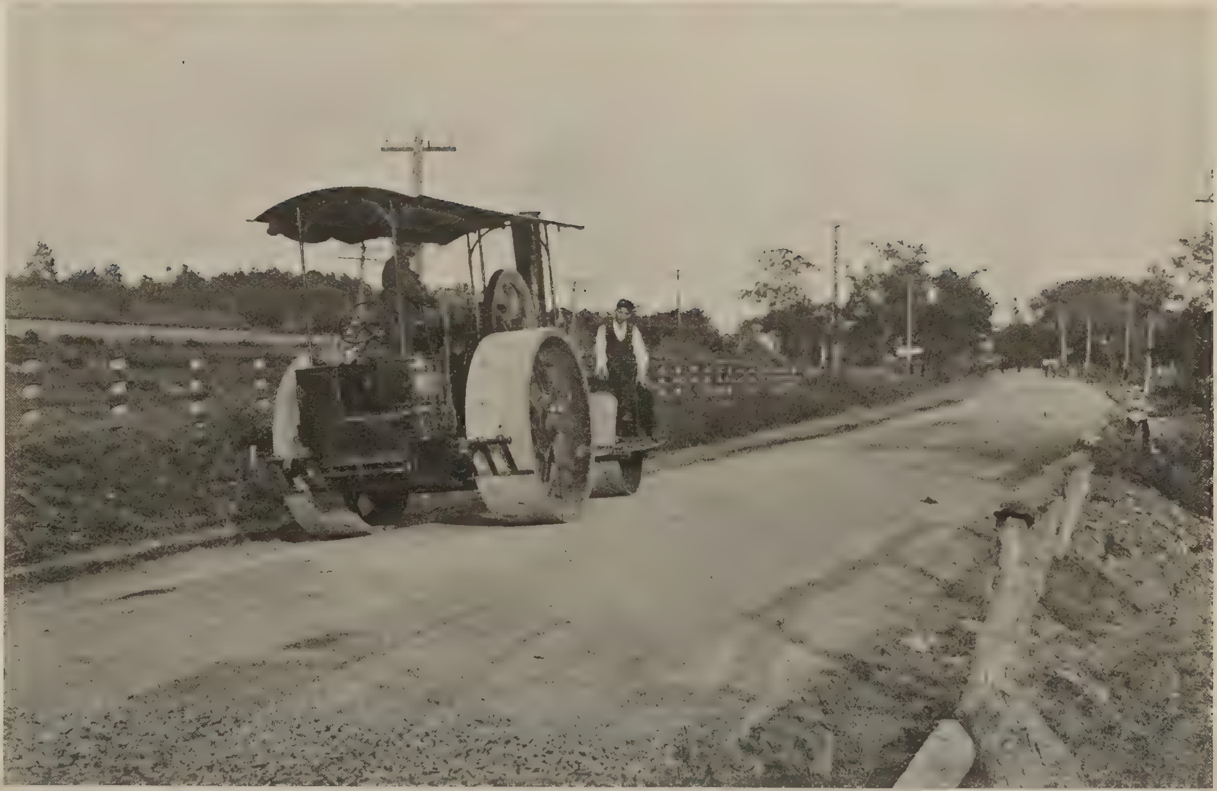

Plate II.—State Highway, Westfield, Mass. Showing steam roller at work on screenings. Finished roadway in the distance. (From photograph loaned by the Massachusetts Highway Commission.)

tled policy of the commission to reduce all grades to a maximum of five feet in one hundred—called a five-per-cent grade. After courses and distances are plotted, and the necessary data obtained for determining the quantity of the various materials used in the construction of a road, a conference is held between the petitioners and the State commissioners, in order to ascertain if a contract for the construction of the road is to be made by the municipality, and, if so, at what price it is to be done. In case the city or town authorities are unwilling to contract for the work upon the prices agreed, the commission advertises the same, and it is let to the lowest responsible bidder, subject to the approval of the Governor and Council. It is the custom in awarding competitive contracts to require the contractor to furnish bonds: one insuring a faithful completion of the work; the other to safeguard the interests of the town or city in case damage results from accidents during the building of the way. Upon the contract being made and a notification being received that the municipality or contractor is ready to proceed with the work, the commission appoints a resident engineer, who has personal charge of the work of construction, subject only to the supervision of the chief engineer.

Now comes the period of actual construction, and the first step in advance is the excavation and filling the road to the required subgrade. In general the subgrade is about nine inches below the finished grade; but the extent of excavation differs widely in actual practice, owing to the different treatment necessary as determined by the varying character of the ground. The subgrade established and rolled, broken stone is then added to a depth of six inches, the fragments varying in size from one and a quarter to two and a quarter inches in their longest dimension. This is then rolled with a steam roller until thoroughly compacted (Plate I). A second layer of broken stone, three inches thick, is next spread upon the road, the pieces ranging in size from one half to one and a quarter inch. This is then rolled as before, and a finishing coating of screenings, put through a half-inch mesh, is then added to a depth of half an inch. Water is now turned on until the broken stone is well wet down, when the final rolling is done, and the surface becomes firmly and smoothly knit together (Plate II). In the foreground of this picture the second layer of broken stone is seen. The main part of the road is in its completed state, having just been compacted with the steam roller. Some modifications are made in these steps of the process, depending upon the quality of the stone used and the amount and kind of travel to which the road is to be subjected. As pointed out by Macadam, it is not wise to place a layer of broken stone directly upon a subgrade of granite or other rock existing as a ledge. Owing to the loss of the element of elasticity, the road would soon become weakened in its coherency, and the rate of wear would be much increased. It is therefore customary to excavate, when a cut in rock is necessary, some four inches below subgrade, and to fill in to subgrade with gravel on which the broken stone is placed as before.

Another modification is practiced when clayey, wet ground is encountered. Under these circumstances it is generally best to excavate some sixteen inches below the finished grade and spread on a layer of gravel four inches deep. Upon this Telford foundation is laid by hand to a depth of eight or ten inches and carefully rolled (Plate III). A layer of broken stone is then put on, and a finishing coating of screenings is added as before.

As to the character of the roads already constructed in Massachusetts, Prof. N. S. Shaler, of the Highway Commission, informed the writer that, in his opinion, they are in no way inferior, in so far as quality and durability are concerned, to the celebrated Swiss roads.

So well pleased are the people of Massachusetts with the State roads already constructed, and so active are they in the cause of good roads, that the Legislature appropriated the additional sum of four hundred thousand dollars for highway construction during the year 1895 and five hundred thousand dollars in 1896.

At first glance it would seem that the engineering skill necessary to construct a Macadam road would not be of a particularly high order; and yet the problems involved in building roads in the latitude of Massachusetts, where great variations exist in the character of the soil, owing to the glacial conditions that once existed here, call for engineering ability of a peculiar kind, as well as an extended experience in the treatment of special cases and the economical application of the materials at hand.

As an adjunct of the Highway Commission, a laboratory has been established in Cambridge, where the systematic study of road materials is carried on. It has come to be generally recognized that materials which possess the necessary qualities for a good road stone are both limited in kind and in quantity. It is the object of these laboratory investigations to classify the road stones of the State in the order of their fitness for this purpose, and to prepare a map showing the area and location of the most desirable varieties. Here are investigated the questions of the rate of wear of stones under impact, and the cementing and recementing value of the powdered rock on which the life of the road depends in a large measure. The hardness and toughness also come within the scope of the experimental work. Experiment has shown that a stone must possess certain all-around properties in order to come up to the desired standard. For

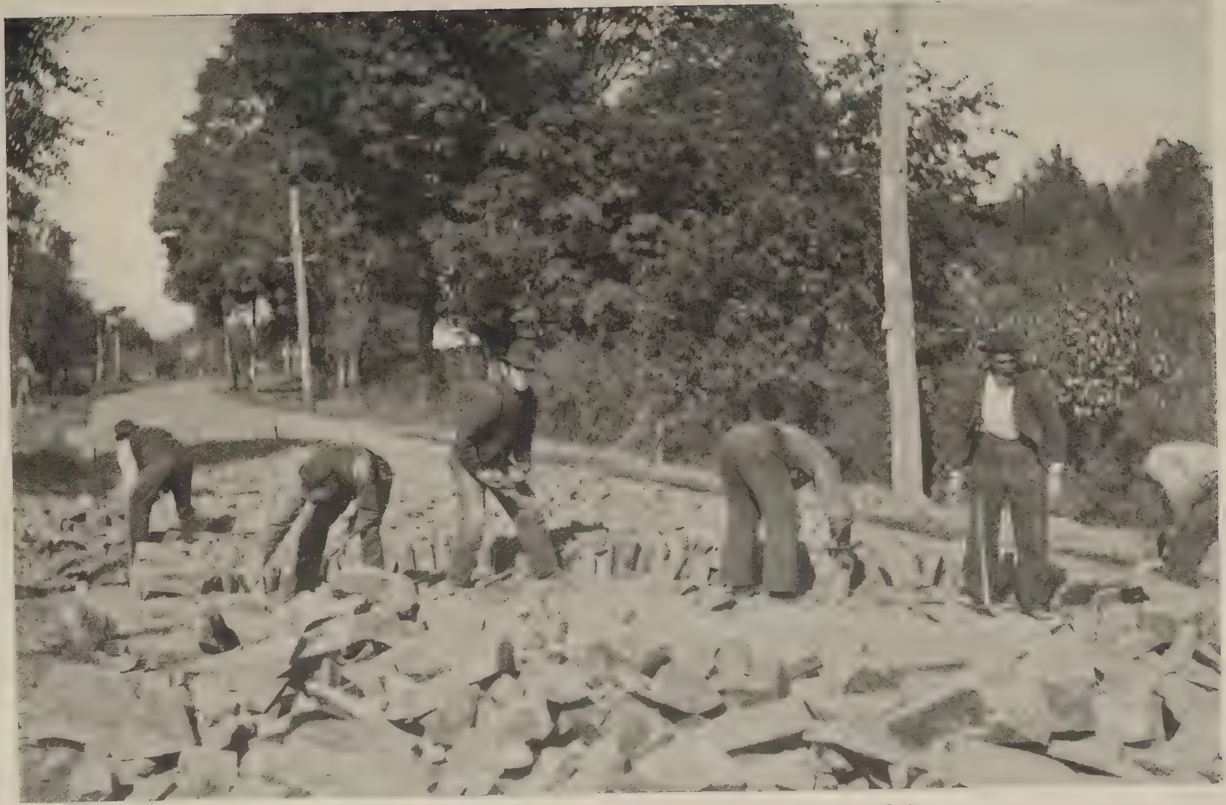

Plate III.—State Highway, Westfield, Mass. Laying Telford foundation.
(From photograph loaned by the Massachusetts Highway Commission.)

example, quartz or quartzite has a hardness of seven in a scale of ten, and for this quality alone it is best suited for road building of any rock of common occurrence; but it does not possess any cementing power or elasticity whatever, and is therefore of little use for Macadam work. As a result of long trial on roads in England and on the Continent, it is found that the stone best suited for road metal must possess toughness and cementing qualities and as great a resistance to abrasion as is possible in a stone having the first two properties. It is an important fact that experimental investigation in the laboratory has pointed scientifically to the same conclusions that have been obtained from the severe test of long experience in actual use.

The most important road stones are known under the common names of "trap" or "dike stones." They are usually of a dark-green color, are fine-grained, and are composed essentially of the minerals pyroxene or hornblende and feldspar, the individual minerals often not being visible to the unaided eye. Geologically, they are rocks that have been forced up through fissures in the earth's crust from great depths, where they existed in a melted condition. Rocks of this kind are very numerous in eastern Massachusetts and generally throughout the old mountain ranges of the United States. The road engineer, however, has other materials besides quarry stone, which, though not possessing so many good qualities, nevertheless make excellent road metal under proper conditions. Among these may be mentioned the blue glacial gravels, kame gravels, beach pebbles, and field stones.

Another rock in common use in various parts of New England is granite (a mixture of the minerals quartz and feldspar) and the allied rock, gneiss. Both these rocks are normally coarse-grained, possessing a hardness, as measured by that of their component minerals, a little under seven. In its use as broken stone granite has certain advantages over quartz alone, in that the feldspar, when pulverized or decomposed by the action of the weather, has considerable cementing value; but the decomposition of the feldspar liberates the quartz, and the physical differences in the matter of hardness, cleavage, etc., between the quartz and the feldspar promote differential wear of the stone as well as other defects. Granite, however, is an important road stone, and is far superior to such rocks as limestones, slates, or marbles, which, owing to their softness, are rapidly worn out.

The production of broken stone has now assumed such importance that several concerns in Massachusetts are making a regular business of furnishing all sizes to the State or municipalities. Broken stone, as a commercial commodity, is now sold on the cars at about one dollar to one dollar and seventy cents per ton for the best quality of trap.

THE DAVENPORT ACADEMY OF NATURAL SCIENCES.

By FREDERICK STARR.

THE scientific work of our Government bureaus and of the great universities of our country is of supreme importance and justly arouses the pride of every American. It is not likely to be overlooked. The work of local societies is less imposing, but is of the highest importance and calls for more than a passing word. In many American cities there are organizations of persons who are intelligently interested in science. These hold regular meetings for discussion, publish papers as new contributions to science, and gather museum collections which serve as object lessons to the public. Few persons realize how much such local organizations, supported by private means and personal enthusiasm, are doing for the cause of science. To make known the story of some of these academies of science and to sketch their work is the purpose of the series of articles of which this is the first. To present their achievements and their claims to respect and assistance is a task which the author gladly undertakes, being one of the many students who have been helped and encouraged by them.

The choice of the Davenport Academy of Science as the subject of this first article is simply from convenience. In some respects the story of its origin and development is typical, in others unusual. There is rather more of personality in it than in most, for the Davenport Academy has had a peculiar environment. When it was organized the city of Davenport was in the "far West"; opportunities for literary and scientific work were meager; the town itself was small, commercial, unsympathetic. That any organization of its kind so far from other centers should exist and thrive was astonishing.

In 1867, on December 14th, four gentlemen—Messrs. L. T. Eads, A. U. Barler, A. S. Tiffany, and W. H. Pratt—met in a business office to organize a natural history society. No one of the four was a professional scientist; all were busy men; none of them was really wealthy. They added names enough to their own to supply officers and a board of trustees, drew up a constitution and by-laws, and then and there became an actual society. Thereafter regular meetings were held and topics of more or less scientific importance were discussed. Before a year had passed the membership had grown to more than fifty, and the attendance at the meetings indicated continued interest. A cabinet of natural history was begun and a place for its display was secured in the rooms of the Davenport Library Association. The first sign, however, that the organization was really purposing to advance the sum of human knowledge was given when the academy arranged for the scientific observation of the solar eclipse of August 7, 1869. The undertaking was a somewhat serious one for the little group of workers. Money had to be secured and subscription lists were passed. Arrangements were made for photographing, and during the two hours of the shadow three dozen negatives were made, of which twenty were fairly good. From them sets of prints were made, some of which were sold to repay expenses, others of which were sent to foreign societies. It was the first exchange contact of the academy with the scientific world.

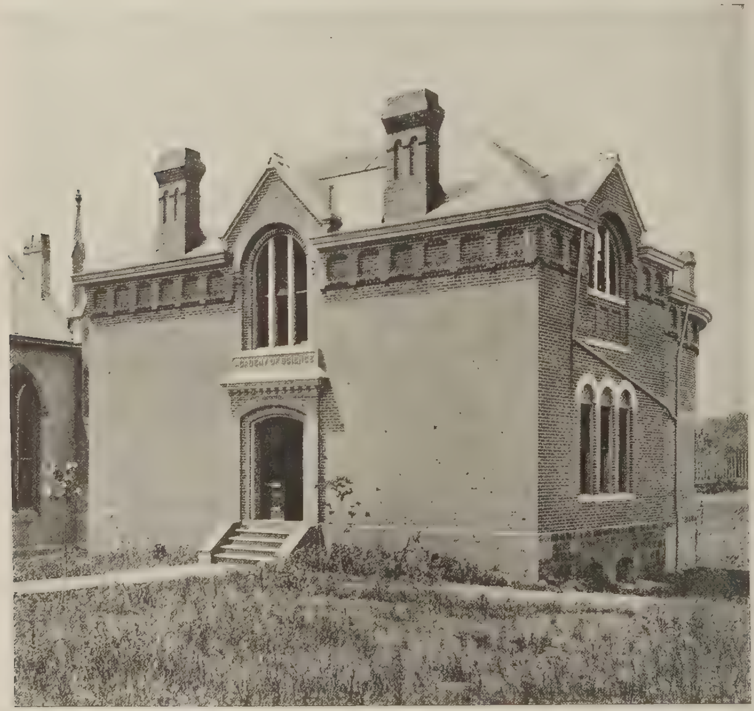

Fig. 1.—Building of the Davenport Academy of Natural Sciences.

In July, 1873, the academy, now nearly six years old, rented "a small back room," into which it put three or four cases for its collection and where for the first time it felt itself at home. The next year more commodious quarters were obtained in the Odd-Fellows' Building. Increasing activity showed itself by weekly *conversaziones* of a popular kind in addition to the regular meetings, by the purchase of a geological library, and by field work in local archæology. More room was necessary, and the lady members—for lady members had been determined to be a good thing—bestirred themselves to secure and furnish a second room. This was progress, but greater things were in mind. Even as early as March, 1873, there was talk of buying property or a building. At that time a combination scheme was in mind, the Library Association, Horticultural Society, and academy uniting in the purchase. Fortunately, the plan failed. On Washington's birthday, 1877, Mrs. Newcomb donated a building lot to the academy. The fever to build was fanned. Before the year ended plans were drawn up and the building erected. Just one year to a day from the donation of the land the building was opened.

The first president of the academy was Prof. David Sylvester Sheldon.* He was born in Vermont, December 6, 1809. At sixteen years of age he went to Castleton Academy, and three years later to Middlebury College, where he was graduated in his twenty-third year. Studying theology at Andover, he never preached, but entered the vocation of teaching. For a time he was principal of the academy at Bennington, Vt., then taught at Potsdam, N. Y., and still later at Northampton, Mass. At thirty-nine years he had lost health and was compelled to travel in the South. Going West later, he settled at Burlington, Iowa, in 1850. When forty-four years old he accepted the chair of Natural Science in Iowa College, then located at Davenport. Later on the college removed to Grinnel, but Prof. Sheldon remained in Davenport, where subsequently he took a professorship in Griswold College, retaining it until his death in 1886. Prof. Sheldon was an inspiring teacher, a man of excellent thought, and of kind and lovely character. He was an ardent collector and student, but not a writer. Local zoölogy and botany occupied much of his attention, and the remarkable collection of fresh-water *Unios* which he made greatly delighted Louis Agassiz. In his botanical field work, the afterward eminent botanist Sereno Watson, then a young man, was associated with him. When the Academy of

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* The list of presidents of the academy is as follows:

1867.—Prof. D. S. Sheldon.
1868–'69–'70–'71–'72–'73–'74.—Dr. C. C. Parry.
1875.—Dr. E. H. Hazen.
1876.—Prof. W. H. Barris.
1877.—Rev. S. S. Hunting.
1878.—Dr. R. J. Farquharson.
1879.—Mrs. Mary L. D. Putnam.
1880.—Prof. W. H. Pratt.
1881.—J. Duncan Putnam.
1882.—Dr. C. H. Preston.
1883.—E. P. Lynch.
1884.—H. C. Fulton.
1885–'86.—Charles E. Putnam.
1887–'88.—Charles E. Harrison.
1889–'90.—Dr. Jennie McCowen.
1891.—James Thompson.
1892.—James Thompson (died night of his election, Dr. William L. Allen, 1st Vice-President, acting President 1892).
1893–'94.—Dr. William L. Allen.
1895–'96.—Edward S. Hammatt.

Science was organized, Prof. Sheldon, then a man of sixty years, was urged to be president. He retained the office only a few months, but up to the last week of his life he was the academy's trusted counselor, constant supporter, and faithful friend.

Fortunately, there was then in Davenport one who was a professionally scientific man—Dr. C. C. Parry. For more than six years he was president of the academy. From the start he held the idea that the academy was called to a higher purpose than to supply pastime to a few townspeople. Charles Christopher Parry was born in Admington, Gloucester, England, August 28, 1823. When he was but nine years old his parents came to this country, settling in Washington County, New York. Educated at Union College, Schenectady, he studied medicine at Columbia College. He settled in Davenport in 1846. There he was a diligent student of the local flora. Later on he examined the mountain flora of California, Colorado, and Mexico. He was official botanist of the Mexican Boundary Survey. Later he held official positions in the Department of Agriculture and as special agent of the Forestry Department of the census of 1880. His journeys to every part of our great Western mountain region were extensive and scientifically productive. He was the discoverer and describer of many new species of plants and of several important genera. His name is associated with that of Torrey and Gray both in geography and on the pages of botanical literature. A man of energy, convictions, and heart, he was the very one to shape and mold a

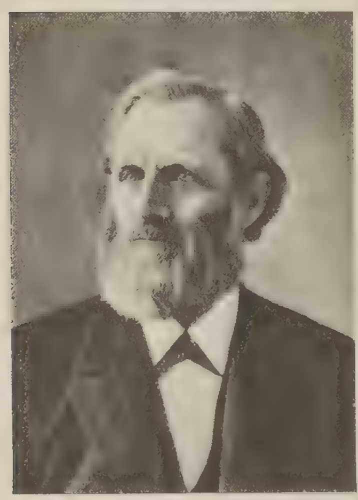

Fig. 2.—David Sylvester Sheldon.

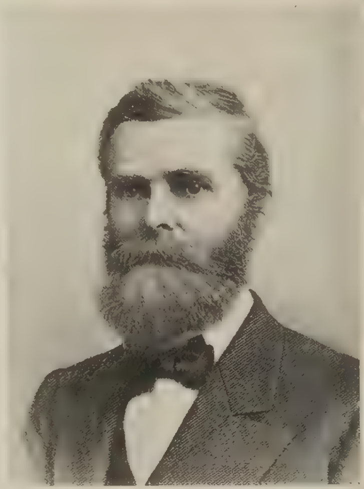

Fig. 3.—Charles Christopher Parry.

young society's work. In one of his presidential addresses before the academy, Dr. Parry emphasized the importance of three things to be held constantly in mind toward which to work. These were (1) a home, (2) a complete *local* collection, (3) publication. These three aims have ever been before the academy. We have seen how they gained the first; the second has been in view from the very inception of the society; the third began early to be agitated.

The election of a schoolboy to membership in a scientific society might seem to mean little, but to the Davenport Academy it meant much. One of the charter members of the academy, Prof. Pratt, was writing teacher in the public schools, giving instruction from building to building. At times he told the scholars to write anything they might have in mind on slips of paper and to hand them in to him. On one such occasion a boy not fourteen years of age wrote the words *Davenport Academy of Natural Sciences.* On inquiry, Prof. Pratt found that the boy had read of the academy in the newspapers and wanted to know what it was. When told of the meetings and collecting excursions he desired to become a member, but only if his mother could become one also. The question of lady members had not before been raised, but now posed it was soon solved. J. Duncan Putnam and his mother were elected to membership, June 2, 1869. The ardent enthusiasm of the schoolboy and the mother's love were to do more for the academy than the few members voting at that meeting could realize. It was this mother's interest that led to the second rented room, to the donation by ladies in 1875 of new cases and carpets, to the gift by a woman in 1877 of the lot, and to much of the energy and interest displayed by the townspeople since. It was the boy's enthusiasm and the mother's love that led to the publication. Impelled by Dr. Parry's words and his own feeling of its importance, J. Duncan Putnam on November 26, 1875, then a boy of nineteen, urged the academy to publish Proceedings. A committee was appointed to look into the matter and to devise means if possible to carry out the plan. December 20th a company of ladies—the Women's Centennial Association—agreed to see that the first

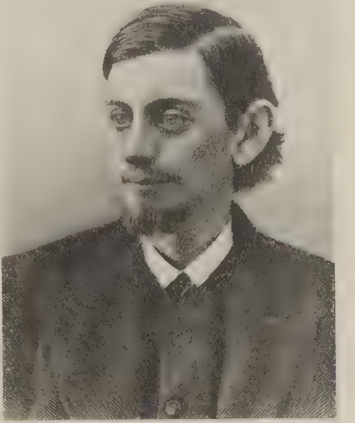
FIG. 4.—J. DUNCAN PUTNAM.

volume of Proceedings, covering the years 1867–'75, should be printed. It was no easy task. Entertainments were given and other ways of raising money devised. A fire interfered seriously, but at last the handsome octavo volume was printed and turned over to the academy. The volume formed part of the display of women's work and achievement at the Centennial at Philadelphia in 1876. The happy result of publication upon the academy was immediately apparent. The Proceedings were sent to all parts of the world, and the library of the academy has grown almost entirely out of its exchange. The publication has not only benefited the scientific world by making known valuable original work, but it has made the academy widely known. The Proceedings have been continued up to the present time, and Volume VII is now in progress. During his lifetime the Proceedings were ever in J. Duncan Putnam's mind. Volume II was due to him, and early in 1881 he offered to turn over to the academy a complete printing outfit and to personally superintend the publication of Volume III. He did not live to complete it, and that volume is a memorial volume, the final bringing out of which is due to Mrs. Putnam. Since her son's death this lady's great desire in connection with the academy has been to see the publications continued. Her energy has never flagged, and finally she has seen the future of the Proceedings assured.

Fig. 5.—Mrs. M. L. D. Putnam.

One of the notable papers in the first volume of the Proceedings dealt with the archæological treasures found by the academy's workers in the mounds of Iowa and Illinois, not far from the city. Local archæology began to attract the academy's attention about 1873. A little group of interested students did the work of exploration mainly at their own expense and often with their own hands. Important objects had been found. In 1874 the academy published a series of seventeen photographs of seven mound-builder skulls. At the 1875 meeting of the American Association for the Advancement of Science, Dr. Robert James Farquharson represented the academy and read a paper upon these finds. It was this paper to which reference is made above. Its author was no common man. Born of a Scotch father and a

Kentucky mother at Nashville, Tenn., July 15, 1824, he was a graduate of the University of Nashville in 1841. At that time Dr. Gerard Troost was connected with that institution, and young Farquharson was profoundly impressed by him. Graduating in 1844 in medicine at the University of Pennsylvania, Dr. Farquharson settled as a practitioner in New Orleans in 1845, and in 1847 was appointed assistant surgeon in the United States Navy. Resigning in 1855, he returned to Nashville and married there. Through the war a strong Unionist, he was in hospital service, and at its close removed to Arkansas. In 1868 he went to Davenport. He joined the academy in its first year, and for twelve years was an important factor in its work. In 1880, being appointed to the State Board of Health, he removed to Des Moines, where he resided until his death in 1884. Unusually modest, quiet, and unassuming, Dr. Farquharson was a profound thinker and an original investigator. Among his notable studies was an interesting investigation upon Leprosy in Iowa.

In this same first volume were several important entomological papers by J. Duncan Putnam. Mr. Putnam's election has already been mentioned and his interest in the Proceedings described. In the history of American entomology there are no more devoted workers. Although dying when most men begin work, he had accomplished more than many who live long. He was born at Jacksonville, Ill., October 18, 1855, his mother being the daughter of the second Governor of Illinois. When a boy of eleven years he began collecting insects, and three years later was a serious student of his gatherings. He joined the society in 1869, and at fifteen years of age, in 1871, was its recording secretary. In 1872 he took a three months' trip into Colorado, where he met John Torrey and Asa Gray, with whom he formed a lasting friendship. In 1873 he was appointed meteorologist on the Jones Yellowstone Exploring Expedition, which was in the field for five months. Returning home, he continued his preparation for Harvard College, but was obliged to give up all hope of a collegiate course on account of failing health. It was in December of that year that his first hæmorrhage of the lungs

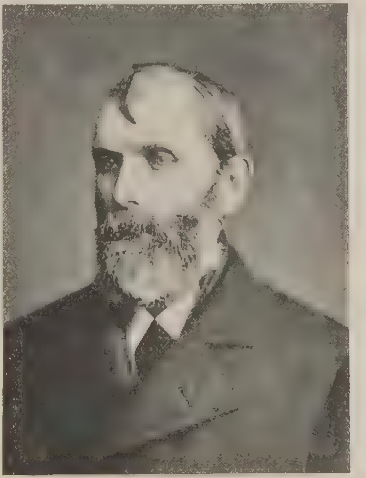

FIG. 6.—ROBERT JAMES FARQUHARSON.

occurred. Although knowing perfectly what lay before him, the young man kept unflinchingly onward. Wrapped up in his loved science and toiling like a strong man in the service of the academy which had won his boy-heart, he kept happily and wholesomely busy to the very end. His labor in a loved cause no doubt prolonged his life, but at last, December 10, 1881, the long-expected summons came. The monument of that young life consists of a series of papers, chiefly entomological, of no mean merit—and the academy. In 1872 Duncan Putnam found his first specimen of *Galeodes*. This belongs to the family *Solpugidæ*, a curious group related to the spiders and scorpions. From that date on his interest centered upon this little-known and curious group. To so good profit did he labor that even now in our latest general authoritative work on insects Prof. Comstock names Putnam as the chief authority. The results of his study were not fully ready for publication at the time of his death, but Prof. Herbert Osborne put them in shape for the printer. They comprise one brief paper—Notes on Solpugidæ, an important Bibliography, and data for a Monograph upon the American Galeodidæ. All of this material, beautifully illustrated by the author's own drawings, was published in the memorial volume of the Proceedings. Besides the material upon the *Solpugidæ*, Mr. Putnam's work includes a score of important papers which were printed in the Proceedings, Popular Science Monthly, United States Government reports, etc. The whole motive in J. Duncan Putnam's work was to do what ought to be done. As he himself once said, "If others are unwilling to do what ought to be done, *I must*." No one outside his family knew him better than Dr. Parry, who said of him: "Though over thirty years his senior in the broad field of Nature, we occupied the same level. Always respectful to my personal wishes or suggestions, never flinching from any imposed duty, always cheerful, hopeful, and zealous, he proved a companion worthy of the highest regard, which he never forfeited either by word or deed." By his activity in field work Mr. Putnam gathered a collection of twenty-five thousand specimens, representing more than eight

Fig. 7.—Captain Wilfred P. Hall.

thousand species of insects. Some of these were type specimens from which he had himself described new species. This whole collection, together with his entomological library, was turned over by his parents to the academy, upon certain conditions securing its proper care and integrity, June 25, 1886.

The archæological work of the academy has been done in two localities. Among Davenport residents who have been interested in the academy is Captain Wilfred P. Hall, better known as "*the old man of the skiff.*" Captain Hall through a long series of years made great journeys on the Mississippi and its tributary streams in a little boat. Among the Arkansas mounds he made extensive diggings and collected many beautiful and valuable relics. The district is a rich one, especially in objects of pottery and shell. When fine specimens were found in private hands, the captain would secure them by purchase or exchange. In his barter, books, including dictionaries, were of special use. After every trip Captain Hall brought back new and interesting material, until the academy's collection was one of the finest, if not the best, from that district. It was this collection that supplied the better part of William H. Holmes's important paper upon the Ancient Pottery of the Mississippi Valley.* Captain Hall's collection is still one of the strongest features in the academy's museum, and the old skiff in which he traveled so many thou-

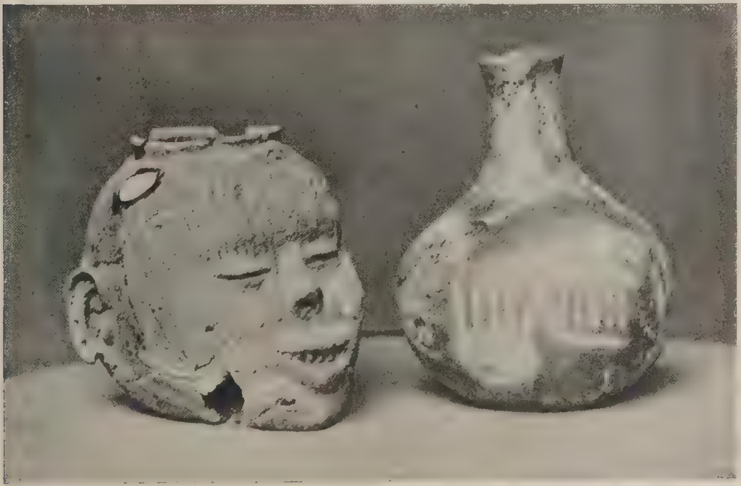

Fig. 8.—Pottery from Arkansas Mounds.

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* Proceedings, vol. iv. Expanded to cover a larger field and under another title in annual report, Bureau of Ethnology.

sands of miles is still preserved on the academy's grounds. The other region archæologically explored by the academy is the local field immediately around Davenport. In the investigations here some most important facts regarding mound construction and burial have been secured and curious and valuable relics found. Among these local relics are skulls, objects of shell, carved stone pipes, copper axes wrapped in cloth (the structure of which has been preserved by impregnation with salts of copper produced by atmospheric action), and stone tablets bearing inscriptions or pictorial designs. None of these relics have attracted so much attention as two of the stone pipes, called from their shape "elephant pipes," and the tablets, which are three in number, two of black slate and one of limestone. About the authenticity of these five objects a bitter controversy has waged. The matter first appeared within the academy August 29, 1884, when attention was called to an article by H. W. Henshaw in the Second Annual Report of the Bureau of Ethnology. In this article the authenticity of the elephant pipes was seriously impugned. A committee was appointed to look into the charge and meet it. A somewhat acrimonious discussion, in which many took part, was conducted in various periodicals. Mr. Charles E. Putnam, father of J. Duncan Putnam, and president of the academy, prepared a vindication, which was published as an independent pamphlet, and later republished with an appendix of congratulatory letters from various archæologists. While this is not the proper place for discussing the authenticity of these specimens, it may not be out of place for the writer to say that to his judgment no substantial argument

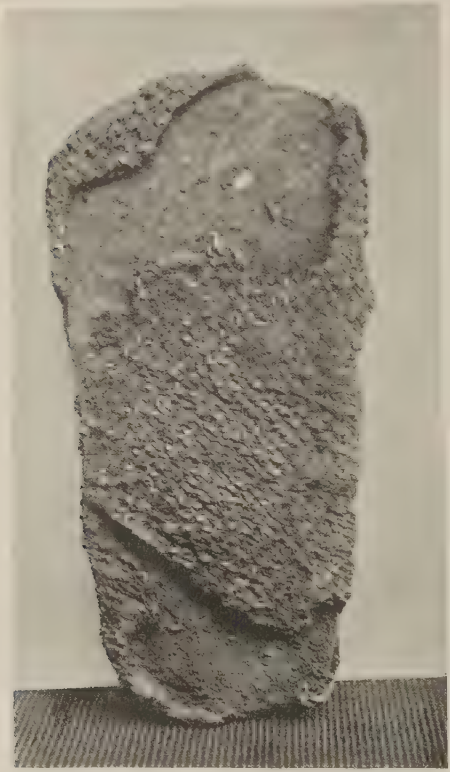

Fig. 9.—Copper Axes wrapped in Cloth.

by the opposition demonstrates either the falsity of the specimens or fraud on the part of the academy. A careful examination of the objects themselves by a disinterested and impartial committee has never been made. Until it has been, every expression of opinion can only be personal.

Up to the year 1883 there was no paid office in connection with the academy. Early in 1882 the heavy labors devolving upon the curator were emphasized, and the payment to him of a salary was uged. Toward the end of that year the modest sum of five hundred dollars was voted as salary, the incumbent being Prof. W. H. Pratt, one of the original four of 1867. At about the same time the financial condition of the academy made a vigorous effort on the part of its friends to relieve it from debt quite necessary. There was a little balance of indebtedness upon the building and other obligations had arisen. An appeal was made to the city, and a citizens' meeting was held on April 24, 1883. At that meeting twelve hundred and ninety dollars was subscribed, and, by a short canvass among the citizens, that sum was raised to twenty-nine hundred and sixty dollars, more than enough to pay all debt. The surplus, amounting to nearly one thousand dollars, was set apart toward a permanent fund, the interest only on which was to be available.

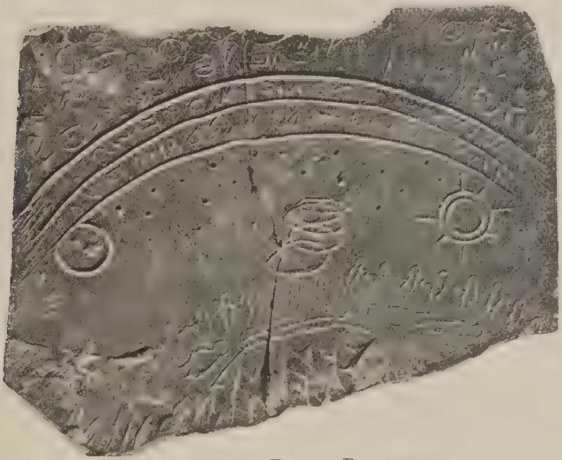

Fig. 10.—Slate Tablet, Davenport.

Just at this time of favorable financial condition came the attack upon the elephant pipes. Whether this was intended to harm the academy or not, it had that result. The society was already weakened by loss of active members. Death or removal had taken from the academy Sheldon, Putnam, Parry, and Farquharson. Interested and self-sacrificing members remained, but they were not professional scientists. The attack surprised some, disgusted others, discouraged more. A few brave workers kept their hands on the work. Among them the curator was indefatigable. The care of the collections was but a small part of his labors. Besides that he had many of the cares of correspondence and of the library. He it was who encouraged the young members of the Agassiz Associations. To make the academy useful to a larger company than its own membership, he organized and delivered courses of popular lectures to the children of the public schools; these were given at the academy, and were illustrated by its collections. Classes from the different schools had their set times for these lectures, and the result of them was encouraging. The experiment might well be tried at other places.

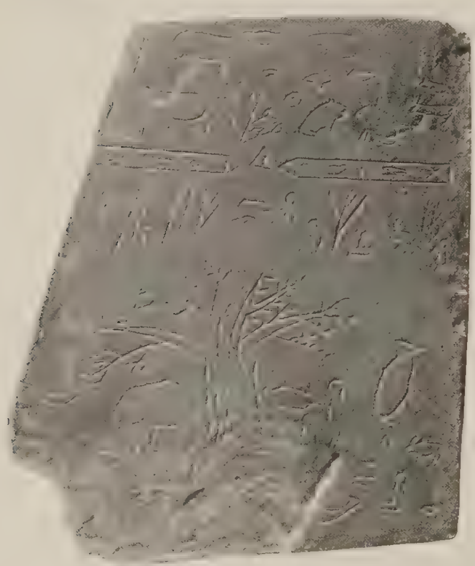

Fig. 11.—Slate Tablet, Davenport.

While not directly an academy enterprise, it is certain that its work and influence led to the holding of the second annual convention of the Agassiz Associations of the United States at Davenport in 1886. There were then two flourishing chapters of the "A. A." in the city, one at the high school and the other in the grammar schools; the combined membership was about seventy. That the active young members of these chapters drew a large amount of their interest from the academy is beyond doubt. The meeting at Davenport was a great success, and young scientists throughout the United States were stimulated by it.

With the death of Charles E. Putnam and the later removal of the patient curator to Minneapolis, the little force of workers was still further reduced. The one thing that held the organization together beyond all others was the publication with the mother love, erecting a monument, behind it. In 1886 the publication fund was begun with a gift from Charles Viele, of Evansville, Indiana, of fifty dollars. From that time the idea of keeping the Proceedings alive was foremost in mind. Mrs. Putnam exercised every energy to secure the funds. The curatorship had passed from Prof. Pratt to Prof. Barris, whose important papers on local geology are a valuable part of the Proceedings. Leaving to him all the curator's duties and more, she devoted herself to this. In 1895 she saw her desires gained: a bequest of ten thousand dollars was left in that year by Mrs. Mary P. Bull as a permanent publication fund, a memorial to Charles E. and J. Duncan Putnam.

With this substantial encouragement the academy now looks forward with increasing hope. Much needed improvements have just been made in building and cases; books have been rearranged in the library; much needed binding of pamphlets and magazines has been done. The membership is increasing, and when the faithful few long toilers are gone new recruits will be ready. Definite plans of growth and development are shaping themselves. An effort is making to raise the *permanent endowment fund* to fifty thousand dollars. When that is done a paid secretaryship can be established to direct and organize the work. Then, with permanent publication secured and direction and activity insured, an effort will be made to complete the building. The edifice already constructed is only the rear part of a far more extensive one. On the lot before it is ample space for a large and imposing structure. The present building is of brick, and is in two stories. The dimensions are shown on the accompanying ground plans. The front door opens on a central hallway, on either side of which is a small, square room. One of these is the office and workroom of the curator; the other contains the *Putnam entomological collection and library*, and is used for the regular monthly meetings of the academy. Behind these rooms is the main museum hall. It consists of a ground floor, with a second-story gallery running around its four sides. On the main floor are the collections in natural history, representing all departments, and particularly rich in local zoölogy and geology. Here are the results of the field work of Sheldon, Pratt, Barris, and

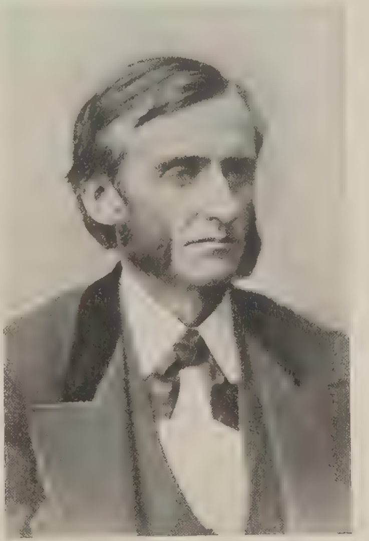

Fig. 12.—Charles E. Putnam.

Pilsbry, not to mention many other local collectors. Here are Captain Hall's collections from Arkansas, and the tablets, pipes, copper axes, and other notable specimens from the local mounds. In the gallery are collections of minerals and an extensive series of stone-age tools and weapons. In front of this gallery and over the hallway and two front rooms of the lower story is the library, which can be used as a hall for a reasonably large audience. The library is one of the best devoted to science in the West, and has been chiefly secured in exchange for the Proceedings. Nominally it contains more than forty thousand volumes; but this number must be considerably reduced, as latterly single issues of periodicals have been catalogued under distinct numbers. With all reductions made, however, the library is important. Publications in twenty-two different tongues are on its exchange list.

Fig. 13.—W. H. Pratt.

Among the most recent subjects in which the academy has interested itself is an archæological study of the State of Iowa, planned by the writer. The plan involves several distinct pieces of work:

1. The preparation of a *bibliography* of Iowa antiquities.
2. The publication of a *summary* of Iowa archæology.
3. Organization of field work throughout the State.
4. Publication of a final report and an archæological map.
5. Preparation of a series of diagrams and casts of an educational character for distribution to the higher institutions of learning in the State.

The first two parts of the plan have been accomplished, and the academy is now endeavoring to carry out the third. While the academy has given and is giving considerable attention to archæology, it is not neglecting other lines of science, and papers of importance in geology, botany, and entomology are in its hands for publication in the near future.

Thirty years is not a long time, even in America. In December, 1897, the academy will celebrate its thirtieth anniversary by a special meeting. It may then look back with pride over its record. From a membership of four meeting in an office, it has grown

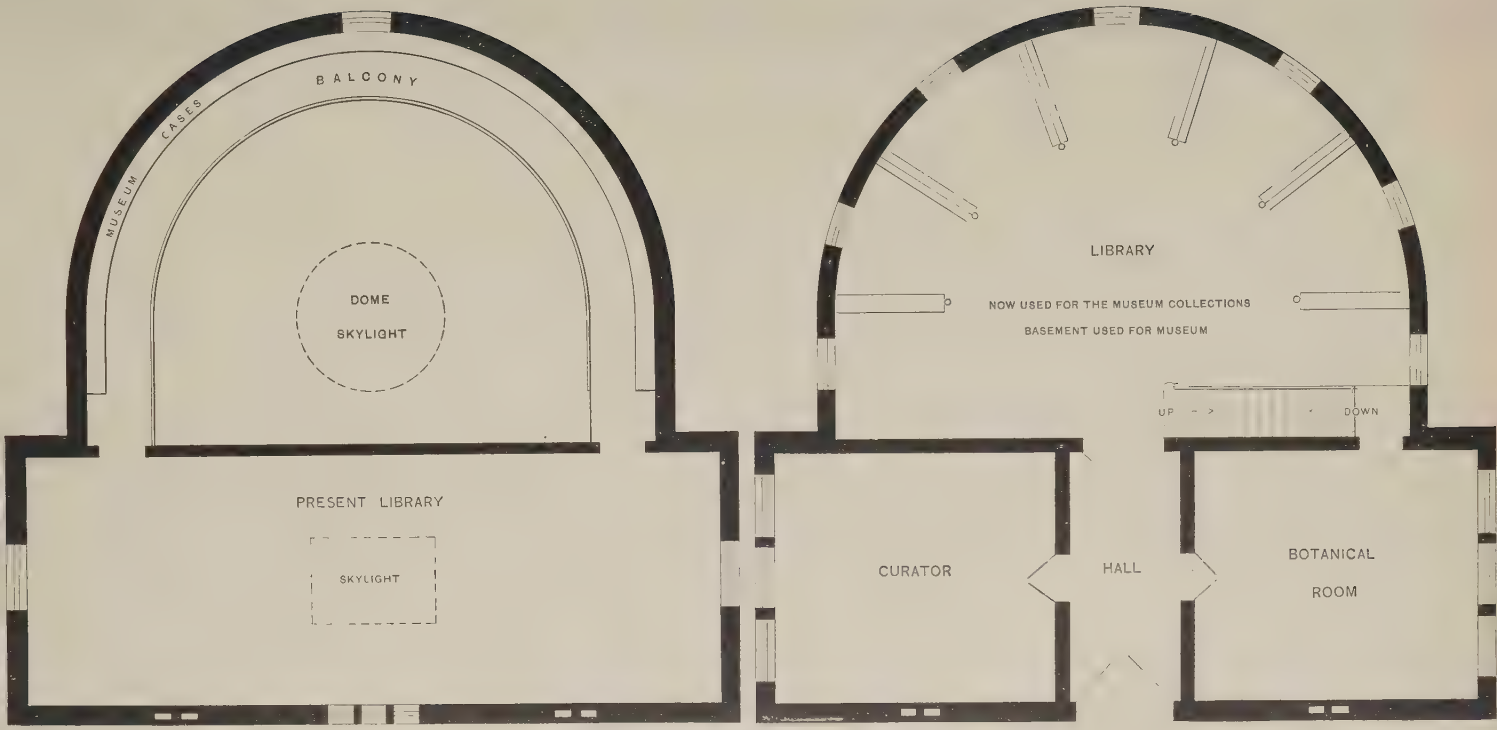

Fig. 14.—Ground Plan of Academy Building.

to one of scores meeting in its own home; it has a neat building free of debt; it pays a curator a regular, if small, salary; it has something toward a permanent endowment fund; with six creditable volumes of Proceedings, it has a permanent invested fund of ten thousand dollars to perpetuate their publication; it owns a valuable museum, which is open free to the public, and acts as a constant incentive to develop scientific interest. And all this has been done by the academy in a small town in the West, without the assistance of any particularly wealthy patrons.

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SOURCES OF THE NEW PSYCHOLOGY.*

By E. W. SCRIPTURE,
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PSYCHOLOGY did not begin with the development of its own methods or in the psychological laboratory; on the contrary, it has been largely the product of other sciences. In most cases the first impulse to the investigation of psychological phenomena was given by the discovery of sources of error in the other sciences which were due to the scientist himself.

In astronomy Tycho Brahe did not accept his instruments as being correct, but determined their errors; it was not, however, until centuries later that a suspicion arose concerning the possibility of errors in the observer himself.

Astronomers have to record the time of the passage of heavenly bodies across parallel lines in the telescope. When the star is about to make its transit the astronomer begins counting the beats of the clock. As the star approaches and passes the line he fixes in mind its place at the last beat before crossing and its place at the first beat after. The position of the line in respect to these two places gives the fraction of a second at which the transit occurred.

In 1795 the British astronomer royal found that his assistant, working with another telescope at the same time, was making his records too late by half a second. Later on, this amounted to 0·8 second. This difference was large enough to seriously disturb the calculations, and, as the astronomer did not suspect that he himself might be wrong, the blame was laid on the assistant.† In 1820 Bessel ‡ systematically compared his observations with those of another observer for the same star. They found a difference of half a second. Later he made similar experiments with Argelander and Struve, with the result of always finding a personal difference.

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* From a forthcoming work, The New Psychology (London, Walter Scott; New York, Scribner).

† Greenwich Astronomical Observations, 1795, vol. iii, pp. 319, 339.

‡ Astronom. Beobacht. d. Sternwarte zu Königsberg, Abth. VIII, p. iii; Abth. XI, p. iv; Abth. XVIII, p. iii.

Bessel sought for the cause of this "personal equation" by varying the conditions. He first made use of the sudden disappearance or reappearance of a star instead of steady motion. The personal difference was much decreased. This seemed to indicate that the trouble lay in comparing the steady progress of the star with the sudden beat of the clock. The next step was to change the beats, with the result that for Bessel the observations were made later with the clock beating half seconds than with one beating seconds, whereas Argelander and Struve showed no particular change. One other point was investigated—namely, the effect of the apparent rate of the star; within wide limits the personal equation was not changed.

About 1838 the personal equation began to receive regular notice in astronomical observations, as appears in the publications of Airy * and Gerling of that year.†

It was natural to wish for a comparison of the astronomer's record with the real time of transit. At the suggestion of Gauss, an artificial transit was arranged by Gerling, the object observed being a slow pendulum. This is probably the first measurement of a reaction time. In 1854 Prazmowski ‡ suggested an apparatus carrying a luminous point for a star and closing an electric circuit at the instant it passed the line; a comparison of the true time with the astronomer's record would give the real amount of his personal equation. From this time onward various forms of apparatus were invented and numerous investigations were carried out. The astronomers found that in such observations sometimes the star was seen to pass the line too soon, sometimes too late, and that the error varied with every variation in the method of observing and in the mental condition of the observer.#

Let us turn for a moment to another science. The new physiology, begun by the pupils of Johannes Müller, in which the phenomena of life were to be explained by physical and chemical processes, had undergone a remarkable development. Du Bois-Reymond had taught how to apply the experimental methods and apparatus of physics to the study of physiological processes. Soon after this Helmholtz measured the velocity of nervous transmission (1850), an experiment that Johannes Müller had

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* Greenwich Astron. Observations, 1838, p. xiii.

† Astron. Nachrichten, 1838, vol. xv, p. 249.

‡ Comptes rendus, 1854, vol. xxxviii, p. 748.

For the history of the personal equation, see Sanford, Personal Equation, Am. Jour. Psych., 1888, vol. ii, pp. 3, 271, 403.

considered hopeless. This involved the construction of the myograph and the application of Pouillet's method of measuring small intervals of time.

The nerves, however, are only the peripheral portions of the nervous system; the desire lay near to measure the time occupied by the brain processes. Such measurements have been (and still are at the present day) impossible by direct physiological methods. It was, however, a sufficiently settled fact that the brain processes are closely accompanied by mental processes. This consideration led to the employment of the time-methods on living human beings. The stimulus was applied to the skin, to the eye, or to the ear, and the time required for the subject to respond by a muscular movement was measured. Since the subject could tell what he experienced under different variations of the experiment it was found possible to measure the time of sensation, of action, etc. The physiological processes corresponding to these mental processes were to some extent known. It was soon discovered, however, that other mental processes—e. g., discrimination, association, etc.—could be introduced in such a way as to be measured.

Beginning with 1865, Donders made a systematic attack on the problem of psychological time-measurements, and was soon followed by Exner. Helmholtz had already directed the experiments of his pupil Exner in measuring the time of sensation, and in 1877 the work of Auerbach and von Kries appeared from his Berlin laboratory.

The interest of the physiologist lay, however, mainly in the deductions to be drawn concerning brain action. Even from the simpler forms of reaction time the amount of physiological knowledge to be obtained is small, and for the more complicated forms it is zero. It was natural, therefore, for physiology to pursue the subject not much further.*

Thus the two sciences of astronomy and physiology discovered and developed the methods of investigating mental times; the further development was the task of psychology.

Another source of the new psychology is to be found in the physiological study of the sense organs. The most obvious method for determining the functions of the nerves and end organs of the skin—the nose, the ear, or the eye—is to ask the living subject what he feels when various stimuli are applied. In this way there has arisen a large body of knowledge concerning the sensory functions of the nervous system. In this form, however, the problem is a purely psychological one. To inquire if the skin

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* For the historical account of experiments on reaction time, see Buccola, La legge del tempo nei fenomeni del pensiero, Milano, 1883, and Ribot, La Psychologie allemande contemporaine, Paris, 1885; for a summary, with literature, see Jastrow, Time Relations of Mental Phenomena, New York, 1890.

"feels" heat is, from a physiological point of view, an indirect question. Physiologically, the nerves of the skin may respond to heat by some chemical process; that they do so respond may be inferred on the hypothesis of a correspondence between the occurrence of a sensation of heat and the action of the nerve. The direct question is one of psychology; it is asked by physiology for its own purposes, and the psychological data are collected as long as they are of use in this way. Physiology, however, is "physics and chemistry of the body," and as soon as psychological data cease to afford physical deductions the interest of the physiologist generally ceases. The study of the psychology of sensation and action, however, has formed and still forms an important portion of physiology.

Historically considered, the study of the sensations of the skin received its first great impulse from Ernst Heinrich Weber's monograph, *Tastsinn und Gemeingefühle.** This has been followed by the work of a host of investigators from the laboratories of Ludwig, Du Bois-Reymond, and their pupils.†

The physiology of the eye originated much of the psychology of sight. Concerning the functions of the optical system, physiology can scarcely be said to have gone beyond the dioptrics of the eye. Nearly all further knowledge consists of deductions from the mental experiences of the subject. For example, physiology knows almost nothing concerning the functions of the retina. Psychologically, however, the color sensations and their combinations can be accurately measured. It is true that the investigations of color vision have been and are mainly carried out by physiologists and physicists; but the point of view has become primarily a purely psychological one. This is strikingly exemplified in the researches of König, from which physiological deductions are practically excluded. For the various other phenomena, such as those of the optical illusions, of monocular and of binocular space, we have at present no hope of anything beyond a psychological knowledge, and the investigations of Hering, Helmholtz, and others can be regarded as direct contributions to psychology.

There is a third science whose influence is to-day the strongest of all. Physics is theoretically the co-ordinate science to psychology. Every direct experience has an objective, or physical, and a subjective, or psychical, side. Again, the fundamental science of Nature is physics, that of Mind is psychology. Practically, however, psychology receives from the most powerful science of modern times an invaluable protection and an uninterrupted series of scientific gifts. The photometry of Lambert led not only to the methods of modern technical photometry but also to the measurement of our sensations of light, while the law of relativity of sensations had been—before Fechner—established for lights by Bouguer, Masson, Arago, Herschel, and Steinheil. The study of the errors of observation in physics and astronomy has led not only to the science of physical measurements, but also to that of psychological measurements. Newton, Young, and Maxwell began not only the science of ether vibrations, but also the science of sensations of color. The laws of mechanics apply not only to inanimate objects but also to the results of our own volitions. In fact, in every department of psychology, progress has been and still is closely dependent on the achievements of physics and technology.

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* Wagner's Handwörterbuch d. Physiologie, 1851, vol. iii (2), p. 561; also separate.

† For summaries and references, see Funke und Hering, Physiologie der Hautempfindungen und der Gemeingefühle, Herrman's Handbuch der Physiologie, 1880, vol. iii (2), p. 287; and Beaunis, Nouveaux éléments de physiologie humaine, vol. ii, Paris, 1888.

Psychology has not only received most of its methods and much of its material from physics; it has for the first time in history reached through physics a definite conception of its own problem. The older psychology and philosophy had always maintained the necessity of directly investigating the facts of consciousness. The standpoint was simple enough, but, as no scientific methods of doing so were developed, the whole problem remained vague and unsatisfactory. Among the proposals for a better state of affairs was that of first investigating the nervous system and then deducing psychological laws therefrom. The brain was to be accurately mapped out into faculties, the paths of nervous currents were to be traced along various fibers, and the interaction of nervous molecules was to be known in every particular; it was even expected that various cells could be cut out, with a memory or a volition snugly inclosed in each. In other words, there was to be no psychology except on the basis of a fully developed brain physiology. Unfortunately, very little has been ascertainable concerning the finer functions of the nervous system. Aside from a general knowledge that the cerebellum has to do with co-ordination of movements, the convolutions of Broca have to do with speech, and similar facts, nothing of even the remotest *psychological* bearings has been discovered concerning the functions of the brain. The roseate hopes of those who expected a new psychology out of a "physiology of mind" were totally disappointed. In the effort for something new, however, the psychologist supplied the data concerning the "molecular movements" in the brain out of his own imagination; the familiar facts of mind were retold in a metaphorical language of "nerve currents," "chemical transformation," etc., of which not one particle had a foundation in fact. The physiology of mind started with an impossibility and ended with an absurdity.

It is to be noted that these statements refer to investigations of and speculations on the brain for *psychological* purposes. For physiological purposes the case is utterly different. The development of brain anatomy and of the knowledge concerning the localization of cerebral functions are among the greatest achievements of modern times.*

Moreover, the collection of facts and the development of theories of the nervous activities accompanying mental phenomena has given rise to the science of physiological psychology.†

With these sciences, however, the psychologist has comparatively little to do. The study of brain function has not contributed a single fact to our knowledge of mental life; the deductions of physiological psychology concerning nervous function have begun with the facts of experimental and observational psychology, and are still so unsettled as not to allow additional deductions backward.

While this was going on, physics had through Helmholtz,‡ Mach,# and others gradually come to a clear understanding of the relation of its facts to the immediate facts of consciousness. Direct experience as present in our sensations was accepted as supplying the facts of physics. For example, in measuring the length of a bar, a visual sensation, the scale of measurement, was applied to another visual sensation, the bar. Indeed, as was clearly recognized, every direct measurement of physics was primarily a comparison between sensations—in other words, a psychological measurement. From this combined measurement the physicist reduced as much as possible the psychological elements; it was but a step for the psychologist to reduce the physical elements in order to have a psychological measurement.‖ This step made psychology for the first time a science in the full meaning of the term, with all the previous achievements of physics for its use.

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* For a historical sketch and an account of the latest remarkable discovery, see Flechsig, Gehirn und Seele, Leipzig, 1896.

† As a representative work see Exner, Entwurf zu einer physiologischen Erklärung der psychischen Erscheinungen, i. Theil, Lepzig, 1894. For a convenient summary see Ziehen, Leitfaden der physiologischen Psychologie, second edition, 1893, also translated.

‡ Helmholtz, Ueber das Ziel und die Fortschritte der Naturwissenschaft, Populäre wiss. Vorträge, Braunschweig, 1871. Helmholtz, Die Thatsachen in der Wahrnehmung, Leipzig, 1879.

# Mach, Die Mechanik in ihrer Entwickelung, Leipzig, 1883, second edition, 1889; also translated into English, Chicago, 1895 (Mach's earlier monographs are mentioned in the preface). Mach, Beiträge zur Analyse der Empfindungen, p. 141, Jena, 1886.

‖ The psychological standpoint has been clearly stated by Wundt, Ueber die Messungen psychischer Vorgänge, Philos. Studien, 1883, vol. iv, p. 1; Weitere Bemerkungen über psychische Messungen, Philos. Studien, p. 463; Ueber die Entheilung der Wissenschaften, Philos. Studien, 1889, vol. v, p. 1; Ueber die Definition der Psychologie, Philos. Studien, 1896, vol. xii, p. 1; Ueber naiven und kritischen Realismus, Philos. Studien, 1896, vol. xii, p. 307. I have followed Wundt in The Problem of Psychology, Mind, 1891, vol. xvi, p. 305; Psychological Measurements, Philosophical Review, 1893, vol. ii, p. 677.

With a real science of the facts of consciousness at hand, the attempt at a "mental physiology" appears as absurd as an attempt to establish a science of meteorology from the twitterings of the birds—especially when the birds are imaginary ones. The physicists have thus not only given to the new psychology its basis, but have also freed it from the rubbish of an overheated imagination.

There is still another source which we must consider, namely, the old psychology. By the "old psychology" we mean psychology before the introduction of experiment and measurement; in its last forms it is the psychology of the Herbartians or of the English associationalists.

We have already seen how the fundamental method, that of observation, was established by the old psychology. The method of direct observation of mental life is the only possible one, and until it had received a firm basis any science of psychology was impossible. As has been explained in Part I, all the other methods of psychology are only refinements of this method. The new psychology is thus merely a development on the basis of the old; there is no difference in its material, no change in its point of view, and no degeneration in its aim. What the old tried to do, namely, to establish a science of mind, and what it did do, as far as its means allowed, the new psychology with vastly improved methods and facilities is striving to accomplish.

This close connection, however, must not involve us in a false estimation of the direct results accomplished by the old psychology. The method of unaided observation was applied to exhaustion, and the later works contained little more than the earlier ones. Indeed, the final sum total of psychological knowledge acquired by this method can be stated to be a mass of ingenious speculations, of endless discussions, and of true and untrue facts; even such achievements as the laws of association have, in the light of newer methods, been shown to be merely superficial arrangements of facts. It has been claimed that unaided observation has yielded valuable storehouses of facts, and it furnishes a special satisfaction to some people at the present day to point out guesses of this older psychology forestalling achievements of the newer science. Among the clever observations concerning facts of mental life and the ingenious guesses at their laws, there are and must be some which are ultimately found to be partially or wholly correct. As Helmholtz remarks: "It would be a stroke of skill *always* to guess falsely. In such a happy chance a man can loudly claim his priority for the discovery; if otherwise, a lucky oblivion conceals the false conclusions. The adherents of such a process are glad to certify the value of a first thought. Conscientious workers, who are shy at bringing their thoughts before the public until they have tested them in all directions, solved all doubts, and have firmly established the proof; these are at a decided disadvantage. To settle the present kind of questions of priority only by the date of their first publication, and without considering the ripeness of the research, has seriously favored this mischief.

"In the type-case of the printer all the wisdom of the world is contained which has been or can be discovered; it is only requisite to know how the letters are to be arranged. So, also, in the hundreds of books and pamphlets which are every year published about ether, the structure of atoms, the theory of perception, as well as on the nature of the asthenic fever and carcinoma, all the most refined shades of possible hypotheses are exhausted, and among these there must necessarily be many fragments of the correct theory. But who knows how to find them?

"I insist upon this in order to make clear to you that all this literature, of untried and unconfirmed hypotheses, has no value in the progress of science. On the contrary, the few sound ideas which they may contain are concealed by the rubbish of the rest; and one who wants to publish something really new—facts—sees himself open to the danger of countless claims of priority unless he is prepared to waste time and power in reading beforehand a quantity of absolutely useless books, and to destroy his reader's patience by a multitude of useless quotations."*

In order to give a psychological illustration, I will refer to the case of mediate association of ideas.† The existence of such associations was discovered in the course of an extended experimental investigation of the manner in which ideas were associated. It was proved, for the first time, that such associations are made. A single personal observation of this sort is to be found in Hamilton's works. A still earlier one is reported from Hume, and a favorable perusal of the works of Aristotle would probably reveal something similar. Such cursory observations, fruitless and unconfirmed, do not entitle the makers to any special credit. The credit of an experimental discovery remains with the discoverer, regardless of previous guesses that may have hit the truth.

The debt of the new psychology to the old psychology of the past does not involve any claims by the "sensation-psychology" of the present. Among the pupils of the old psychology there were necessarily many who grew up in ignorance of the new, or who did not learn of its existence until too late for changing the mode of thought. Just as the old psychology led to an improved science on the part of the progressive men, so it led to a degenerated form on the part of the others. Unable to grasp and to apply the methods of true science, these men can not even understand what the new is all about; and in their attempt to do something new they have fallen into the absurdities of "psychical research," or "experimented" with spiritualistic mediums, or gathered "statistics" concerning ghosts, or interviewed the several personalities of the hypnotic subject.

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* Helmholtz, Popular Lectures, Second Series, p. 228. New York, 1881.

† The idea, C, follows a totally unrelated idea, A. A and C had previously been independently associated with B, but now B is not thought of, or is entirely forgotten.

The older psychology, with its traditions and its dignity, was a discipline to be treated with filial consideration and respect; but the latest "sensation-psychology," plunged in the dregs of all the mysticism and superstition of the middle ages, not only contributes nothing to the progress of science, but arouses in opposition to it all the ghosts of the witches' caldron.

Summarizing, we are entitled to say that the new psychology is the old psychology in a new phase of development; that the impulses to this development came from physics, physiology, and astronomy; and that the resulting application of the best methods of modern science to the great problems handed down from the past is what makes the new psychology a true science worthy of its origin.

THE LATENT VITALITY OF SEEDS.

By M. C. de CANDOLLE.

SEEDS that remain in keeping without losing the faculty of germination are said to be in a state of latent life. The term is not exact, for it leaves us still to ask whether the life of the seeds is completely stopped, or is simply slackened in its activity—questions to which the same answer can not be given under all circumstances. It may be that a seed will continue to respire without producing any formation of new histological elements, when a loss of substance results to the plantule it contains which is compensated for by the assimilation of reserve materials from the *energides*, or living protoplasmic masses of the cells. A plantule may be supposed to live in this way for a considerable time if the temperature is favorable and the seed and the surrounding air are not too dry. Under these conditions the latent life may be considered one of slackened activity.

An experiment by MM. Van Tieghem and Bonnier proves that seeds may retain their vitality for a considerable period in this condition. Three lots of peas and beans were left—one in the open air, a second in a sealed glass tube containing common air, and a third in a sealed tube containing pure carbonic-acid gas. At the end of two years the seeds of the first lot had perceptibly increased in weight, and nearly all germinated; those kept in confined air had increased less in weight, and fewer of them germinated; the air inclosed with them in the tube had changed in composition, having lost oxygen and gained carbonic acid. Of those sealed up in carbonic acid, the weight had not changed, and none germinated.

While these results show that the seeds continued to lead a retarded life in open and in confined air, it is possible that the retarded life was only of short duration, and that it had ceased, before the end of the experiment, to give place to a complete stoppage of respiration, assimilation, and life. But to admit this we have to suppose that the protoplasm in seeds in latent life finally becomes wholly inert, while it preserves its composition and its internal chemical structure. This view seems to be confirmed by a number of experiments and observations which I am about to describe.

I have already several times related experiments that prove that seeds may be subjected to a very intense cold for many hours in succession without losing their germinating faculty. A recent experiment of this sort, made with M. Raoul Pictet's apparatus and under his direction, proves that some peas and beans and fennel seeds germinate quite well after having endured for four days a temperature of − 200° C. (− 328° F.). The seeds had not undergone any previous desiccation, and no precautions were taken to adjust the depression of temperature. Others of M. Pictet's researches have demonstrated that the chemical reactions which take place at ordinary temperatures cease to be produced at very low temperatures, like those reached in the experiments just mentioned. If this is so, we may suppose that the protoplasm of seeds exists during these experiments in a condition of complete inertia, without either respiring or assimilating. In other words, life is then really stopped; yet this does not prevent their vegetating anew when the conditions of temperature and moisture permit it. The seeds in these experiments were cooled so very rapidly that it is natural to suppose that their protoplasm was already quite inert before the test began. It would be hard otherwise to explain its complete indifference to abrupt variations of temperature, which would certainly have been more harmful if they affected protoplasm still active.

Another experiment I have recently tried casts more light on this point. Wrapping seeds of wheat, oats, fennel, and the sensitive plant in packages of tinned paper and inclosing the whole in a sheet-iron box, hermetically sealed, I placed them under the cover of a wooden box in a compressed-air refrigerator for meats, where they were exposed for a hundred and eighteen days to repeated but not continuous refrigerations, most of which lasted twenty hours each. The lowest temperature reached was – 53·89° C. (– 65° F.); the highest, – 37·78° C. (– 36° F.); and the mean, – 41·93° C. (– 43·4° F.). After each refrigeration the temperature rose to that of the interior of the receiver, but slowly, while the refrigerations were rapid.

After the conclusion of the experiment, when taken out of the refrigerator and planted, the wheat, oats, and fennel came up promptly; only thirteen out of sixty seeds of sensitive plants germinated, and of lobelia seeds, which were too small to be counted, only ten. The failures of the sensitive-plant seeds could not all be attributed to the cold, for others of the same species which were not refrigerated did but little better. The lobelia seeds were, however, certainly killed by the cold, for the control seeds germinated abundantly. It is safe, too, to infer that seeds can remain inert and unharmed in a medium unsuitable for respiration, provided nothing is present to injure their protoplasm through chemical action. Such a medium, for example, would be an atmosphere of carbonic acid.

I desired to ascertain the effects on germination of keeping seeds in vacuum. The most obvious way of trying this experiment, by the formation of a barometrical vacuum, was liable to the objection that the abrupt removal of the air and moisture might disturb the tissues and modify the structure and composition of the protoplasm of the seeds, and thereby produce a complication of results. I therefore tried another way, by immersing them in mercury under such precautions that no air could reach them other than what they contained within themselves. The results agreed substantially with those obtained by refrigeration, and go to confirm the view that seeds can continue to subsist in a condition of complete vital inertia, from which they recover whenever the conditions of the surrounding medium permit their *energides*, or the living masses of their cells, to respire and assimilate.

At first sight, this return to life resembles the resumption of motion by a machine that has been resting when it is put into communication with its motor—a comparison which has been often made. But the phenomena are not of the same nature in the two cases, and the *energides*, of which the total constitutes the living individual, are not machines in the usual sense of the word. For a machine works without changing its structure, while the *energides* segmentate after they have grown, and their segmentations operate in their turn as *energides*. This is because the matter assimilated by living protoplasm augments its mass without diminishing its energy. For it to be so, this mass must evidently continually receive new portions of energy, and this can come only either from the surrounding medium or from the reactions that go on in the protoplasm itself. In the former case the agency consists of radiations of different sorts, and is of a purely physico-chemical order; while this can not be in the second case. In fact, the life of protoplasm is manifested by movements which are combined in such a way as to produce an orientation of its parts according to certain structural dispositions succeeding one another in a determined order; phenomena to which ordinary physico-chemical actions never give rise. We are therefore necessarily led to suppose the existence of a special class of reactions of which assimilated matters become capable only after their absorption into this special medium, living and pre-existing protoplasm, into which they penetrate.

Under this relation we might, in a certain way, compare assimilation to what occurs when combustible matter takes fire on being heated in a furnace in which a combustion is already going on, and is kept up by the new matter. So, one might say, it is only after having been previously put into a special condition by their mixture with protoplasm that assimilable substances react among themselves in such a way as to produce a new quantity of living matter. So one may suppose that protoplasm in the condition of latent life, having become inert but retaining the faculty of reviving, resembles those mixtures formed of substances that do not react except under certain conditions of temperature or other influences, and which, so long as those conditions are not fulfilled, continue indefinitely in contact without combining. Such, for example, are explosive mixtures.

The presence of assimilable matter in protoplasm or within its range is not sufficient for the production of the phenomena of assimilation and orientation. Certain conditions of temperature, moisture, and aëration have to be realized. As long as they are not realized, and if nothing occurs to change the composition or structure of the *energides*, they will remain inert, while they retain the faculty of evolving anew when the circumstances become favorable again.

Such condition of chemical and vital inertia may probably endure for a long time, possibly indefinitely. This, as it seems to me, is at least the only way of accounting for the preservation of seeds during very many years. Cases are in fact known where seeds have germinated after so prolonged a rest that it is impossible to assume that they have lived during the interval even a retarded life. We cite a few examples. M. A. P. de Candolle * speaks of seeds of the sensitive plant that germinated after more than sixty years of rest. Girardin* saw beans germinate that were taken from Tournefort's herbarium, where they had been kept more than a hundred years.

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* Physiologie, p. 621.

In 1850 Robert Brown, out of curiosity, sowed some seeds from the collection of Sir Hans Sloane, of which they had formed a part for more than a hundred and fifty years. He succeeded in making several of them germinate, particularly a seed of *Nelumbium speciosum*. The plant has been preserved in the galleries of the British Museum,† where I saw it a few years ago.

The pretended germination of wheat from mummies is said to be a fable. It seems, besides, that wheat was always sterilized before being introduced into the sarcophagi, so that the possibility of its being brought to life again was excluded in advance. On the other hand, various well-verified facts have demonstrated that seeds may preserve their faculty of germinating after an extremely prolonged abode underground—that is, when sheltered from atmospheric influences. The most extraordinary case of this kind was observed a few years ago by Prof. de Heldereich,‡ director of the Botanical Garden at Athens. While herborizing around the mines of Laurium, this naturalist discovered, in 1875, a *glaucium*, which he unhesitatingly considered a new species, and described under the name of *Glaucium serpieri*. The plant had just made its appearance on a tract from which had recently been removed a thick bed of scoria produced in the workings of the mines by the ancients, or at least fifteen hundred years ago. Unless we assume a spontaneous generation, this *glaucium* must be regarded as a species which existed formerly in the place, the seeds of which had been preserved intact under the protection of the ground and the scoria that covered them.

Many instances are mentioned in which the opening of deep trenches or the clearing of forests has been followed by the appearance of species formerly unknown in the place. Prof. Peter, of Göttingen,# has very recently made a long series of methodical researches, the results of which are of great interest. His method consists in collecting specimens of forest earth, the age and all the anterior conditions of which are fully known. He cultivates them, taking all precautions against introducing foreign seeds. These specimens of earth are always taken from

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* Sur la propriété qu'ont certaines espèces de graines de conserver longtemps leurs vertues germinatives.

† See Gartenflora, 1873, p. 323.

‡ These facts have been recently confirmed by Mr. W. Carruthers, director of the botanical galleries in the British Museum.

Nachrichten v. d. königl. Gesellschaft der Wissenschaften u. d. Georg-Augustus Universität zu Göttingen, November, 1893, and December, 1894.

thickly shaded spots, destitute of all other vegetation except the moss that carpets the surface of the soil. Holes are dug under this moss, from which the earth is taken at depths successively of eight, sixteen, and twenty-four centimetres. The specimens taken from these several depths are cultivated separately. The cultivations, prolonged for more than three months, have all ultimately given rise to plants the seeds of which must of necessity have remained under the earth for a greater or less length of time.

M. Peter has carefully indicated in detail the plants that corresponded to each of the specimens of earth on which he operated. It resulted from the experiments that the specimens of earth from very old forests gave plants of the woods, while those from forests of more recent date yielded species the nature of which was manifestly related to the previous disposition of the soil—that is, plants of the fields or the meadows, according as forestation had replaced one or the other of these methods of cultivation. While he is extremely reserved as to the probable duration of the abode of the seeds in the soil, M. Peter concludes in these words: "Although the experiments in cultivation just described do not furnish a solution to the question of the length of time during which seeds at rest preserve their faculty of germinating, the conclusion results from this demonstration that for many field and meadow plants this duration may considerably exceed a half century."

These researches of M. Peter's deserve careful attention, and it is to be hoped that they will, without delay, be imitated in other countries and different kinds of land, for they may reveal very important facts in biology and prehistoric botanical geography. Alphonse de Candolle * insisted a few years ago on the desirability of making soundings beneath the snows of the Alps with a view of recovering vestiges of the vegetation anterior to the Glacial period. It is to be regretted that no one has carried out this idea, for the facts I have just summarized almost permit us to hope that research of this kind may lead to the recovery of still vital seeds dating from very remote epochs.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

THE managers of the Cornell University Experiment Station Extension Work are able to draw comfort even from seemingly the most unpropitious conditions. They represent that they have been greatly aided in their mission of extending the knowledge of plain facts and enforcing their meaning "by the hard times and multitudes of bugs and special difficulties. These things have driven people to thinking and to asking for information."

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* Extract from the Archives des Sciences physiques et naturelles.

STRANGE PERSONIFICATIONS.

By M. TH. FLOURNOY.

WHILE cases of colored audition and visual schemes are quite frequent, we have fewer instances of that special kind of synopsy which I call *personification*, because it consists, in its typical form, in the concrete representation of a personage —sometimes of an animal or a thing—being regularly awakened by a word that has no comprehensible relation with its curious associate. This sort of personification in its marked degrees is rare, and in the few instances that have come under my knowledge has been applied to the days of the week.

In M. E. F——, student in letters, nineteen years old, the figures of persons of very definite pose and occupation are provoked by various suggestions; among others, by those of the days of the week. Monday and Tuesday are to him a young man of serious aspect, with his forefinger on his eye—dark weather. Wednesday is a young man in the act of stealing something behind him, stooping down and putting his arms between his legs to take it. M. F—— does not see what this man takes, and does not know what it is; dark weather. Thursday is a man turning the knob of the kitchen door to go through that room to the next one. Friday is a man selling something on a wagon, which he holds with his hands. The object is indistinct, and M. F—— does not know what it is, but in his mind the man is the Wednesday man, and is selling the thing he stole on that day. The weather is clear. Saturday is a man falling against a door and putting both hands forward to push himself back, falling again, and so on several times. He is doing this for amusement. Sunday is a man buttoning his cuffs, and the weather is fine.

It will be seen that in respect to their psychological nature these personifications are a triple mixture of visual representations, of interpretative ideas (the idea of Wednesday's man stealing an object which is the same unknown thing that he sells on Friday, etc.), and of general impressions corresponding with the weather that is prevailing—except Thursday and Saturday, which have no weather assigned to them. The visual representatives of mental images do not take on the character of hallucinations, but remain simple mental images. These personages have no color, and their dress is extremely indefinite, but their figures are very sharply defined. M. F—— distinguishes all these details, and perceives clearly the expression, which is always serious (with the exception of Wednesday, who laughs while he is stealing his object). The localization of these visual images is not less precise. The man of Monday, for example, appears to

M. F—— always outside of him, but very near—hardly a yard away; he is and always has been of the same size as he, from which he concludes that they have grown up together. The man of Wednesday and Friday, on the other hand, is always seen at a considerable distance—more than fifty yards.

M. F—— does not personify any figure or number, except 14, which represents itself to him as an accountant sitting at his desk, writing. Of the months and seasons, only autumn is personified, as the same sad-looking man with his finger on his eye who represents Monday and Tuesday.

Most of the common nouns are associated with personifications, or rather were; for the phenomena were formerly much more numerous and persistent than now. M. F—— does not recollect having ever had such visions for isolated syllables, articles, pronouns, and other words without special significance; yet, at an age when he knew nothing of the gender of words or of sex, the letters of the alphabet called up—some (A, B, C, D, etc.) the image of a pair of trousers, and others (as H, M, N, R, etc.) of a robe. Words of a positive significance invoked representations largely independent of their real sense. Bottle, for instance, invoked and still invokes the image of a large woman, laughing, sitting on a little backed bench, with a table in front of her, but no other suggestion of a bottle in the vision. *Shark* (*requin*) is personified in a large horse stationed near the subject and by the side of a load of hay.

These parasitical representations, grafted on the word and always accompanying it, were often considerable impediments to conversation and reading. Now, with a few exceptions—such as the days of the week, the figures of which are still very intense—the images do not rise in the course of conversation or of an interesting reading, but they appear readily enough on reflection or when the book is a dull one. The relations of the personification and of the real idea are reversed in this way: Formerly the induced representation preceded the thought of the proper meaning; now it comes after it or remains latent, except in a few instances—as, for example, shark, where the image of the load of hay and the horse appears before the idea of the fish. M. F—— believes that his personifications reached their greatest intensity in his childhood, when he was seven or eight years old, and that they have progressively diminished since he was twelve. He formerly thought that as a rule everybody had similar impressions, but he was met with surprise and ridicule when he spoke of them to others.

M. F—— can say nothing of the cause of these curious phenomena; he finds them as far back as his recollection can reach, almost unvarying in intensity and inexplicable. A very small number permit glimpses into their origin; it is, for example, probable that habitual or verbal associations have had a part in suggesting the likeness of Sunday to a person buttoning his cuffs, and of Friday (*vendredi*) to a man selling (*qui vend*) something placed upon a *van*. The masculine or feminine character of the dress attributed to the letters seems to be suggested by the pronunciation (*b*, masculine; *m*, feminine, etc.). In like manner, the personification of the word *college* may be explained as a youth wearing a large white collar (*col*) turned back on his jacket as children's collars are. So the word cat (*chat*) brings up the image of a cat with a twist in its mouth, as if it were laughing, because, perhaps, M. F—— had an impediment in his speech in childhood which caused him to make a face when he tried to pronounce the letters *ch*. But, while M. F—— regards these explanations as very plausible, they are still only hypotheses to him; for he has no precise conviction, no sure recollection that such were indeed the causes of his inductions in these cases. The special incidents to which these speculations apply are relatively very few, and his speculations as a whole are entirely enigmatical.

Perhaps their origin will become a little less obscure if we make account of the exaggeration which follows a process in M. F—— that is familiar to us all in a lower degree. When we hear somebody we do not know spoken of, or when the author in a romance introduces a new character, we spontaneously form an idea of his appearance and moral qualities which is not exclusively based on what we are told of him, but in which our fancy involuntarily participates to a considerable extent. Yet this idea usually remains vague and indecisive till more ample information comes to it, susceptible of being modified and enriched according to the course of events. With M. F—— this fanciful anticipation of the facts operates with exceptional promptness, while the images it engenders are distinguished by a rare persistence. A proper name is enough to call up in him, without any known reason, a complete and precisely defined figure, which thenceforth continues so fast attached to the name that meeting with the person himself does not dissociate it. Thus, M. F—— conceived the two Coquelins, before he had seen them, by virtue of their identity of name, in exactly the same form and with identical heads. He was much surprised not to see me wearing the full black beard he had immediately given me the first time I was spoken of to him. I supposed the beard belonged to another person of his acquaintance whose name had some similarity in sound with mine; but he did not think this was the case, and could not give any explanation of the fact. He can not even tell whether it is the auditive perception of the name, or its appearance when written, or its articulation, or a mixture of all these that induces his personifications. This shows how unknown and mysterious are those associations with which the creative activity of the imagination is fed, which a single word suffices to bring into play, and of which a notorious consequence is the well-known importance attached by novelists to the choice of names for their heroes.

The rapidity of the evocation of the images and their tenacity when they are once formed appear especially marked in the ideas M. F—— conceives of the characters in a book. From the first two or three lines relative to a character he sees him rise in his mental vision, often very different from the description given by the author. A person described as blond, for example, appears brown to him. The representation, however, persists firmly, and the reading of the story does not modify it. No matter if the little girl of the first pages does grow and change her character in the course of the volume—she always continues to him the little girl of the beginning. When he reads the book a second time, after the lapse of a few months, the identical personifications appear again unchanged. It is not so with the pictures of places, likewise arbitrary and inexplicable, which M. F—— associates spontaneously with every scene he reads about, and also, in a smaller degree, with stories told him. These pictures, which are usually recollections of childhood without connection with the subject of the reading—a description of a mountain, for instance, suggests the recollection of a plain—have some degree of permanence in that they do not vary from one day to another during the time he is occupied with the book; but when he takes up the volume again some time afterward he finds that they have changed. He remembers very well on every occasion the image of the place which he had before, and finds that the story now calls out another. This variability of local images, in opposition to the fixedness of personations proper, points to their greater immediate dependence upon the subjective dispositions of the movement.*

These details seem to me, if not to exptain the inexhaustible phantasmagoria of M. F——'s personifications, at least to illustrate the special kind of imagination under the dominance of which they spring forth. This imagination is characterized by the union of two properties akin to those of sealing wax: great docility in receiving an impression at the right moment, and—that moment once past—an equal rigidity which opposes itself to any further modification of the impression. Novelty, emotional excitement, or a happy concourse of circumstances, accomplishes here what heat does for sealing wax, and permits the fixation of the group of images, disordered as they may be, that burst out at the opportune moment. But while we can expose the wax again to the fire, these curious products of fancy do not bear remelting, and the ideas or the cerebral cells continue fixed in the fortuitous relations that were contracted at that privileged instant. How else can we account for associations so absurd and at the same time so persistent as that of a day of the week with a person stealing or selling some indefinite thing? We can not reconstitute the striking incident or the collection of unforeseen relations and subtle analogies which accomplished the soldering of two such heterogeneous things in M. F——'s mind; but it is supposable that the operation is effectuated at once, and that the initial plasticity was immediately spent; for the thing stolen and sold continues always indistinct, in spite of the natural curiosity which would ultimately have precisely identified it, if the activity of the imagination had retained the slightest hold upon it.

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* For analogous examples of curious evocatioms, but apparently inconstant, induced by reading or thought, see M. Pilo's Contributo allo studio dei fenomeni sinestesici. Belluno, 1894, pp. 7, 8.

The same remark may be applied to the other incomprehensible details abundant in M. F——'s personifications. We might speak of fragments of dreams suddenly registered and riveted forever to the words which the caprices of the nocturnal imagination had momentarily brought into relations with them. The dissociation of words from their usual sense and their application to other images by virtue of a connection which the dreamer clearly feels and finds quite natural, but which vanishes on awakening to give place to the opposite feeling of complete incoherence, are in fact a frequent feature of dreams. In the personifications the images attached to the words independently and outside of their proper sense are nearly always as arbitrary as the dream, but permanent, and the connection is felt by the subject, although he himself knows that it is irrational and inexplicable.

The physiological conditions of this singular process are still unknown to us. No evidence of heredity has been brought to light in the particular case. Still, the fact that M. F—— has never met an echo in his family when he speaks of his impressions does not prove that his parents have not in their infancy experienced similar phenomena, which have disappeared and been forgotten in older life.—*Translated for the Popular Science Monthly from L'Année Psychologique.*

An amusing story is told in his Notes from a Diary by Sir E. Grant Duff of the London Metaphysical Society, now defunct. It is to the effect that Sir John Simeon, after one of the society's early meetings, rushed up to one of the members and asked, with the appearance of great anxiety, "Well, is there a God?" "Oh, yes," was the reply, "we had a very good majority."

SKETCH OF JAMES NASMYTH.

JAMES NASMYTH was pre-eminently a self-made man. Though taught in the schools, he worked out his own way without regard to the teaching he had received, and by methods peculiarly his own. He was a master engineer, an astronomer whose discoveries and conclusions attracted the attention of learned societies and were admired by the great, and a successful manager of men. "There can be no doubt," says Nature, in a sketch of him, "that he stands in the front rank of those who have advanced the material interests of mankind by the application of science to industrial methods."

Mr. Nasmyth was born in Edinburgh, August 19, 1808, the next to the youngest child of a family of eleven, and died in London, May 7, 1890. He was the son of Alexander Nasmyth, an artist of considerable distinction, and reckoned in his ancestry two or three successive generations of architects and builders. Mention is made of his exercise of his observing powers in very early infancy. The conditions of his childhood life, although it was passed in the city, gave him opportunities to become acquainted with Nature. Many workshops were in operation near Calton Hill, where the nurses took the children to play, and he was one of the throng of little boys who were interested in watching the proceedings of the workmen. Having tools at home in his father's shop, he tried to imitate what he had seen done. He became skilled in making things for himself, and was called "a little Jack of all trades." He was taught by his eldest sister, then sent to a teacher of such a character that he contracted "a hatred against grammatical rules," and was enrolled in the Edinburgh High School in 1817. The teaching here was of the old routine sort, and aroused little interest in the pupil; but he did his tasks punctually and cheerfully, "though they were far from agreeable."

A different condition prevailed in the shop, where his father directed his attention to the action of the tools and to all the processes required for turning out the best work; and gradually he had planted in his mind "the great fundamental principles on which the practice of engineering in its grandest forms is based." Nasmyth became famous in the school for the perfect spinning tops, or "peeries," he could make, for his accurate construction of kites, and for his paper balloons. He cast, bored, and mounted small brass cannon, and made guns of cellar keys. With the fine steels he made he was able to buy the monitors off from the too strict enforcement of the assigned tasks. But he learned little of what the school taught—"a mere matter of rote and cram." He formed intimacies with fellow-pupils that proved of value to him: with a youth whose father had a foundry, where he spent profitable hours, and with another whose father had a special genius for practical chemistry, and made colors and white lead; signals were arranged with this boy, so that when anything particular was going on at the laboratory Nasmyth was notified of it; and the boys made their own reagents, and acquired considerable skill in producing various substances.

Nasmyth left the high school at the end of 1820, not much the better for his small acquaintance with the dead languages, but the mathematical studies had developed his reasoning powers. He practiced accuracy in drawing, made his own tools and chemical apparatus, and interested himself in the volcanic geology of Edinburgh. He attended the Edinburgh School of Arts from 1821 to 1826, and at seventeen years of age he was constructing steam engines of different designs and for various purposes. He heard the lectures at the university on chemistry, geometry and mathematics, and natural philosophy. He established a brass foundry in his bedroom, but did his heavier work at George Douglas's foundry, for which he made an engine to drive the lathes, the operation of which had such an enlivening effect on the workmen that the proprietor affirmed that the output was nearly doubled for the same wages. He made an expansometer or instrument for measuring in bulk all metals and solid substances, which so pleased Dr. Brewster that he described and figured it in the Edinburgh Philosophical Journal. He experimented upon steam carriages for highways, and hit upon a device for increasing the draught of the engine chimney by the use of waste steam that George Stephenson had adopted, and which has given the locomotive its efficiency.

When it became possible, Nasmyth went to London to visit Henry Maudsley, the great manufacturer of machines, and seek employment in his establishment there. Maudsley's experience with pupil apprentices had not been pleasant, and he was not at first willing to employ him; but when the young man said he would consider himself fortunate if he could even be employed to clean the ashes from the furnaces, Maudsley answered, "So you are of that sort, are you?" and his heart was opened at once. Nasmyth exhibited his drawings the next day, and Maudsley instituted him his assistant workman, or private secretary, as no apprenticeship was needed in his case. His first work was on a machine for generating "original screws"; next, in connection with the construction of two small models of engines, he invented a device for exactly reducing bolt-nuts. Being given a month's vacation in the fall of 1830, he went to Liverpool to witness the performance of George Stephenson's locomotive, "The Rocket." With the desire to see all he could on his return of the mechanical, architectural, and picturesque, he determined to walk leisurely back to London. He was impressed with the pretty surroundings of Manchester, especially as seen from the Patricroft Bridge; visited the cotton mills, and continued his walk to London, occupied with the thought of settling down in the busy neighborhood he had just left.

Mr. Maudsley died in February, 1831, and Mr. Nasmyth continued to work with his partner, Mr. Field, till the latter part of that year, when, in the twenty-third year of his age, he decided to go into business for himself. Mr. Field was pleased with his intention, and gave him facilities for starting. He went to Edinburgh and set up a small temporary shop, where he made himself a set of engineering tools. He subsequently chose Manchester as his permanent place of business. He found a shop in an eligible situation, with convenient appurtenances, but in a building occupied by other tenants. The time of his starting in Manchester was an auspicious one for his business. Workmen of all kinds were short of the demand, and, taking advantage of the scarcity, were disposed to be careless, irregular, and insubordinate, and machine tools, which would not get drunk or go on strike and were unfailingly regular and accurate, were in great request. Mr. Nasmyth got his full share of the work of supplying these tools: planing machines, slide laths, drilling, boring, and slotting machines, and others; and orders pouring in upon him, his flat became loaded with work. He having constructed an engine that was almost too large for the shop, one end of the beam, while it was being taken apart for shipment, crushed through the floor, disturbing the tenant below, and it had become evident that he needed a larger shop. He found a site within the very landscape that had attracted his attention years before, as he was resting at the Patricroft Bridge. He built there the celebrated Bridgewater Foundry, and took in Mr. Holbrook Gaskell as a partner. Observing the inconvenience and danger attending the operation of the foundry ladle then in use, he invented the screw safety ladle, with which, he says, some twelve or sixteen tons of molten iron could be decanted "with as much neatness and exactness as the pouring out of a glass of wine from a decanter."

The maxim of the Bridgewater Foundry, "Free trade in ability," was put in force early in its operation. By this maxim was meant promotion of the workmen according to the skill and activity they displayed, without regard to the kind of apprenticeship they had served. This conflicted with the rule of the trades unions, which required a seven years' apprenticeship, and the inevitable strike and picketing occurred. Workmen were brought from Scotland, the trades unions were conquered, and the foundry continued to practice and exemplify its maxim unmolested. The practice was "to employ intelligent, well-conducted young lads, the sons of laborers or mechanics, and advance them by degrees according to their merits. They took charge of the smaller machine tools, by which the minor details of the machines in progress were brought into exact form. . . . A spirit of emulation was excited among them. They vied with each other in executing their work with precision. Those who excelled were paid an extra weekly wage. In course of time they took pride not only in the quantity but in the quality of their work, and in the long run became skillful mechanics. . . . The best of them remained in our service, because they knew our work and were pleased with their surroundings; while we, on our part, were always desirous of retaining the men we had trained, because we knew we could depend upon them."

The rapid extension of railroad construction, and the orders that consequently came in, led to much attention being given at Bridgewater to the building of locomotives, for which the machine tools used there gave great advantages. The Great Western Railway Company ordered twenty large engines, offering to add £100 to the contract price of each if they proved satisfactory. The premiums came, and with them a letter from the board of directors of the company offering to stand as references as to the quality of Messrs. Nasmyth and Gaskell's work. The Great Western Railway Company having successfully dispatched its steamship Great Western between Bristol and New York, and having elected to construct another steamer, the Great Britain, procured tools for making the engines from the Bridgewater Foundry. They were perplexed, however, about the forging of the intermediate paddle shaft, which was to be of a size never before attempted. They applied to Mr. Nasmyth, and he devised the steam hammer, the most famous of his inventions—an instrument with which, as he says in his autobiography, the workman might, "as it were, think in blows. He might deal them out on to the ponderous glowing mass and mold or knead it into the desired form as if it were a lump of clay; or pat it with gentle taps, according to his will, or at the desire of the forgeman." All was going well for setting the hammer in operation, when the plan of the vessel was changed by the introduction of the screw propeller, which rendered the immense shaft unnecessary. No patent was taken out for this invention, but the drawings of it were kept in the shop, open to the inspection of visitors. Among those who looked at them were M. Schneider, and M. Bourdon, his foreman, of the great iron works at Creuzot, France. A few years afterward, when Mr. Nasmyth visited Creuzot, he admired the excellence of a certain piece of machinery, and asked M. Bourdon how the crank had been forged. M. Bourdon replied, "It was forged by your steam hammer." Mr. Nasmyth was then taken to the forge department, where he saw this "thumping child of his brain," which for him had existed only in his books, at work. The foreman had recollected the drawings, and embodied them substantially in the machine. Mr. Nasmyth at once secured a patent, introduced some improvements, and made the construction of the steam hammers a branch of his business. Though he was prompt enough in explaining to them the merits of his invention, it took considerable time to arouse the official minds of the Lords of the Admiralty, "who are very averse to introducing new methods of manufacture to the dockyards." But after he had furnished hammers to the principal manufacturers of England and had sent them abroad, these dignitaries learned in the course of three years that a new power in forging had been introduced. A deputation visited the foundry to see the invention, and were pleased and "astonished at its range, power, and docility." An order came for a hammer for the Devonport Dockyard. Their lordships were present when the hammer was started, and Mr. Nasmyth "passed it through its paces." He made it break an eggshell in a wineglass without injuring the glass. It was as neatly effected by the two-and-a-half-ton hammer as if it had been done with an egg spoon. Then "I had a great mass of hot iron swung out of the furnace by a crane and placed upon the anvil block. Down came the hammer on it with ponderous blows. My lords scattered and flew to the extremities of the workshop, for the splashes and sparks of hot metal flew about. I went on with the hurtling blows of the hammer and kneaded the mass of iron as if it had been clay." Orders followed to supply all the royal dockyards with a complete equipment of steam hammers.

The extension of the docks at Devonport called for an immense amount of pile driving. The contractor for the work had witnessed the operation of the steam hammer, and asked Mr. Nasmyth if the principle could not be applied to the pile driver. Such a pile driver was constructed. It was tested. Two piles of equal length and diameter were selected, one to be driven with the new machine and the other in the old way. The result was four minutes and a half with the former to twelve hours with the latter; and the steam-driven piles were hardly bruised, while the others suffered in the usual way.

Mr. Nasmyth had the satisfaction of seeing many of his mechanical notions adopted by rival or competing machine constructors, with or without acknowledgment. By the steady application of the rule of "free trade in ability" the factory was kept above trouble with the trades unions, being always able to find competent and interested hands to take the place of those who might be disposed to go out on strike; and it was a source of the greatest pleasure to the proprietor, "when looking round the warehouses and factories, to see the intelligent, steady energy that pervaded every department, from the highest to the lowest." Other features of the Bridgewater factory were the manufacture of small engines for various purposes, in which a large business was done; the utilization of waste steam for heating and drying; improvements effected in calico-printing machinery; the furnishing of machine tools to the Woolwich Arsenal, which Mr. Nasmyth had found, when he inspected it, "better fitted for a museum of technical antiquity than for practical use in these days of rapid mechanical progress"; and the supply of rope-making machinery—a new line of work—to the Russian Naval Arsenal at Nikolaiev, on the Black Sea.

In 1854 Mr. Nasmyth took out a patent for puddling iron by means of steam, in which the superfluous carbon was removed by the oxygen arising from the decomposition of the steam. About a year afterward Mr. Bessemer brought out his invention for effecting the same purpose by a blast of air, and it totally eclipsed Mr. Nasmyth's process; but Mr. Nasmyth consoled himself with the thought that he was a kind of pioneer of the invention, and Mr. Bessemer offered him a third share of the interest in it. But Mr. Nasmyth "was just then taking down his signboard and leaving business," and thankfully declined the offer. He bought a place near Penshurst in Kent, and naming it Hammerfield, after his hammers and the family crest, retired to it in 1857, when he was forty-eight years old, and spent the rest of his life there.

Here he indulged himself with complete freedom in the study of astronomy, in which he had been engaged as an avocation for many years. He had made a very effective six-inch reflecting telescope as early as 1827, and had instructed Mr. Maudsley in the art three years later. He then made a speculum ten inches in diameter—composing the alloy himself—of such quality as evoked admiration from Mr. Lassell, and cast a thirteen-inch speculum for Mr. Warren de la Rue, whose interest in astronomy had been awakened by witnessing his processes. With his ten-inch telescope he began observations in a general way, which gradually became particular. In time he substituted for this a twenty-inch reflector with improvements that made it more convenient to use, and in 1842 began his systematic researches on the moon, making careful drawings in black and white of the features that attracted attention, and thereby training his eye for more accurate observation. A series of these drawings, with a large map of the whole visible surface of the moon, was first exhibited at the Edinburgh meeting of the British Association in 1850, and afterward at the Great Industrial Exhibition of 1851—where, besides a council medal for his steam hammer, Mr. Nasmyth was given a complimentary notice for the lunar pictures—and to the Queen and Prince Consort personally. In the course of his astronomical observations he turned to consider the causes of the sun's light and other phenomena of light and heat. In May, 1851, he sent a communication to the Astronomical Society embodying his views that the light of the sun was simply the result of an action on that body of ethereal matter distributed through space unevenly, so that its intensity would vary as the system passed through different regions; that variability in stars might be thus accounted for; and that our Glacial period was produced by the solar system passing through a region deficient in power of luminosity. Mr. Nasmyth found afterward that these views were paralleled in some features of the theory of the sun enunciated by Dr. Siemens in 1882. He delivered a lecture on the Structure of the Lunar Surfaces before the Edinburgh Philosophical Society in 1858, and in 1874 brought out his book on The Moon considered as a Planet, a World, and a Satellite—a work which at once made its mark in selenological literature. He busied himself also with the study of the spots on the sun, and made the novel discovery of the willow-leaved structure of the solar surface, which attracted universal attention among astronomers. Sir John Herschel complimented him upon it in his Outlines of Astronomy; the astronomers at Greenwich made observations that confirmed it; and Father Secchi was trying to illustrate it by sprinkling rice grains over a blackboard covered with glue at the very moment Nasmyth was introduced to him by their fellow-astronomer Otto von Struve. We should mention, too, in connection with his astronomical studies the paper which he presented to the Royal Astronomical Society about 1851 on the Rotatory Movements of Celestial Bodies, which was suggested by the motion of that kind acquired by water running out of the bottom of a basin. Mr. Nasmyth was also interested in microscopy, and studied twenty-seven forms of infusoria in the water of the Bridgewater Canal; in photography, and made models of parts of the moon's surface and photographed them; in the origin of the form of the Pyramids, which he attributed to the appearance of the sun's rays streaming through clouds; and to the derivation of the cuneiform characters from the shapes of the impressions made by striking soft clay with the corner of a parallelogram-shaped instrument. He wrote Remarks on Tools and Machinery in Baker's Elements of Mechanics (1858).

Editor's Table.

SOCIAL NEEDS.

IF the word "socialist" could be defined as one who concerns himself with the interests of society, who makes those interests his own, then it would be well if we were all "socialists." So long, however, as it means a person who wishes to transfer to everybody the authoritative direction of everybody else's business and the control of everybody else's property, we must leave the use of the term to those who accept responsibility for the advocacy of such ideas. Meantime, it is a matter for the daily consideration of all men of good will what are the most pressing social needs of the hour, and how they can best be met.

Among the phenomena of our time in this country there is none, we think, more striking than the great development of our institutions of learning. Partly through public grants and partly through private donations, the means available for higher education have within the last quarter of a century, even within the last dozen years, been enormously increased; and, as has lately been remarked, there will shortly be little need for American youths to repair to foreign universities in order to obtain the latest and best results of research in almost any department of knowledge. In other words, this country is already well equipped for the formation of a cultured and learned class, and is yearly increasing its facilities and resources in that direction. This is true even in regard to branches of scholarship, such as the classical languages and philology, which might be thought less likely to awaken interest in a new and democratic community. Whatever advantage, therefore, can come to us from a liberal provision for the higher learning we may consider as already assured.

That culture and learning are delightful and profitable possessions no one, we think, but an extremely uncultivated and narrow-minded person would deny; but, taking what may be called a sociological view of the subject, we have sometimes been led to wonder whether the immense sums of money which have been appropriated of late to university purposes have really been bestowed in the manner most useful to the country at large. A day or two ago our eye fell upon the following observations in one of our most valued contemporaries: "In truth, one of the most startling things in connection with our collegiate education is its failure, as a rule, to prevent the graduate, when he enters politics, from sinking mentally to the existing political level. This has been the history of the larger number of what are called our 'gentlemen in politics.' They rarely spend a year with politicians without adopting their standards and their view of civilization." Most persons, we imagine, can confirm this from their own experience. But, if the scholar sinks through contact with the politician, how are we to explain the low level at which the latter lives? With whom is he in contact on the other side? There is only one answer: With "the people."

This makes us reflect. Millions are being given for the endowment of the higher learning—that is, for the creation of a learned class. What is that learned class going to do for the rest of the community? The members of it will make, no doubt, delightful society for one another; but, from the wider sociological standpoint, what function are they going to fulfill? Will they in any powerful and effective manner help to sustain and strengthen the ideality of less favored classes; or will they live their lives apart, each in his own little "palace of art" constructed by the spirit of self-love and exclusiveness? If they can be counted on to do the former, then the millions are most wisely expended; but if the latter is to be the outcome, then, beyond all doubt, the millions might have been better applied. We believe in natural differentiations, but not in artificially created distinctions; and unless our highly educated class can accept and discharge some social ministry that will have the effect of communicating to others some share in what they have obtained themselves, it seems to us that this vast expenditure of money for higher education may lead to social results of a rather undesirable kind. The university graduate, as we have seen, is cutting a very poor figure in politics. The politicians by profession will not let him do otherwise; and he seems to have no power whatever of appealing to or influencing the people against the politicians. The reason why he is thus powerless—admitting, what perhaps there is no reason to admit in some cases, that he has any ideal of his own above the common—is that the life of the people is almost untouched by any kind of ideality, and that the popular habit of mind is opposed to the recognition of any leadership based upon superiority of mental or moral endowment. We are thus led to the unwelcome conclusion that there is but little diffusion of culture in any true sense among the people, and that it is the general lack of it, and the absence of any interest in larger questions, which give to our politics that character of dreariness and pettiness, not to mention a constant tendency to corruption, which all careful observers have noted.

One careful observer has lately consigned his observations to the pages of the Atlantic Monthly; we refer to the article contributed to the March number of that periodical by Mr. Francis C. Lowell, under the title of Legislative Shortcomings. It is of the Massachusetts Legislature, in which he had two years' experience, that Mr. Lowell speaks. "The first object," he says, of a member elected thereto, "is to secure the passage, or more rarely the defeat, of some legislative measure of only local importance. . . . Occasionally, but not often, this measure is an iniquitous job. Usually the member has no pecuniary interest in it, and often it is little more than a matter of legislative routine. Even when it is unwise, it is frequently nothing worse than a piece of legislative fussiness; or perhaps it was devised to meet some local demand, and is objectionable only on account of the bad precedent it establishes; such, for example, as acts to enable a particular town to subsidize a steamboat or a variety show for the convenience or amusement of its summer visitors. . . . If the member's pet measure is not a local matter, but an act of general importance, he runs the risk of being deemed a crank. If he should strenuously seek the passage of several measures, really important, he would be thought wholly devoid of common sense, and his influence would soon disappear." Then, in order to get his own little bill passed, the member, Mr. Lowell tells us, has to trade his vote—that is to say, he must vote for other men's bills, be they good or bad, if he wishes them to vote for his. If he should fail to do this, "his constituents, without regard to party or condition, would probably deem him faithless to his principal duty."

If such things are done in the green tree of Massachusetts, what may we expect in the drier wood of less happily conditioned States? The Atlantic Monthly would render a great service if, taking this article of Mr. Lowell's as the first of a series, it would give us a dozen or so of similar studies of other State Legislatures. Nothing would more effectually hold up to us a mirror in which to see our true social and political status. Meantime let us first ask how such a condition of political intelligence as Mr. Lowell depicts tallies with the vast apparatus we already command, and the vaster we are daily acquiring, for the promotion of higher learning. When do our learned men propose to swoop down from their heights with culture in their wings for the help and inspiration of the masses of their countrymen? Or is this a matter which they think may safely be left to the common schools?

In this uncertainty as to what the learned classes are going to do for the commonwealth, we sometimes wonder whether it might not be possible to divert advantageously to purposes of popular culture some portion of the wealth which is now finding its way in lavish streams to already well-endowed seats of learning. How the money, if available, could best be applied is an interesting question as to which we should be glad to receive suggestions from our readers. We have more than once heard regret expressed—and we share the feeling ourselves—at the almost complete disappearance of the lecture system which was doing so much useful work a generation ago. The newspaper has superseded the platform; and yet the platform, we do not hesitate to say, was a more civilizing force in some respects than the newspaper. For one thing, it "uttered nothing base," which is more than can be said for the newspaper. It gave the people high thoughts, interesting ideas, pure sentiments, and useful knowledge. It was not occupied with idle gossip, or mean personalities, or the criminal side of life. It is not fully replaced even by *good* books and papers. As Prof. Corson says in his interesting little book on The Aims of Literary Study: "The intellectual coefficient can be apprehended through silent reading; the main object of vocalization is to exhibit the spiritual coefficient, which is indefinite to the intellect, and needs to be vocally rendered as much as a musical composition needs to be vocally or instrumentally rendered." There was, moreover, a certain social stimulus afforded by the lecture system which the private reading of even good literature does not supply.

We conceive, therefore, that a wealthy man, desiring to benefit the people at large, might with great advantage establish not lectureships but rather readerships. The literature of to-day and of past days contains ample material for the instruction and delight of popular audiences if read aloud by a properly trained elocutionist. Our idea would be to have such readings entirely free, except that local expenses in the way of hall hire, etc., might be met by the locality; and we should further propose that the reader should in each place that he visited give a course of lessons, also free, in correct reading. For the results which might be expected to accrue from such measures we would refer to the little work by Prof. Corson already mentioned, and to another by the same author entitled The Voice and Spiritual Education. If Prof. Corson is right, culture, no less than faith, comes mainly by *hearing;* and an agency, therefore, by which the best literature of the day and of all days should be brought home to people's hearts through the tones of a sympathetic human voice could not fail, in course of time, to produce very beneficial effects both mental and moral. Within the household itself nothing is more humanizing than good reading (aloud); and this would be promoted by such public readings and such instruction as we have in view. We hear not infrequently of gifts of a million dollars or more to a single university; and we think it is time that something should be done for those who have no opportunity to become very learned, but whose minds might by proper effort be attuned to what is best in literature, and thus raised above the dreary level of commonplace ideas and petty personal concerns.

SPENCER AND DARWIN.

A COUPLE of years ago, as some of our readers will remember, a book was published under the title of From the Greeks to Darwin, in which the history of the doctrine of evolution was sketched, or at least purported to be sketched, from the earliest times down to our own day. The most remarkable thing about the book was that, of set purpose, it ignored the greatest thinker on evolutionary lines that the world had ever seen; we mean, of course, Herbert Spencer. This omission was duly noticed in our columns at the time, and there is no need to go over the ground again. What we wish to say to-day is that, if Mr. Spencer's position in relation to the doctrine of evolution needed any vindication, it has received it in ample measure in Mr. Edward Clodd's recently published book, Pioneers of Evolution, and in the article by Mr. Grant Allen contributed to the Fortnightly Review and republished in our last number. No one can read either the one or the other without feeling that to discuss evolution in its broader aspects without making due mention of Spencer is like narrating the discovery of America with but slight mention of Columbus. To Mr. Spencer we owe a rational and systematic statement of the doctrine of universal evolution; to Darwin we owe an original and lucid explanation of the natural process by which species are modified and new species formed. The latter was indeed a most solid and substantive piece of work, but it did not furnish the general formula of evolution, which but for the labors of Herbert Spencer would still be to seek. It was Darwin himself who said of Spencer: "I suspect that hereafter he will be looked upon as by far the greatest living philosopher in England; perhaps equal to any that have lived."

We feel how times have changed when to be recognized as a potent contributor to the establishment of the doctrine of evolution is one of the highest honors, if not the highest honor, which a philosophical thinker can enjoy. When Darwin published his Origin of Species, and for some years later, his name was cast out as evil; to-day it is difficult to keep an admiring public from claiming for him the authorship of that much wider scheme of evolution for which Mr. Spencer properly stands sponsor. The record, however, is very clear, and no one needs to be in error as to the respective achievements of the two men. Both have done great work for the intellectual emancipation of mankind, and the names of both will go down with glory to posterity.

Scientific Literature.

SPECIAL BOOKS.

THE first volume of the Story of the West Series dealt with a class that is becoming smaller and weaker, the second concerns one that is growing larger and stronger.* The miner, however, is changing his characteristics hardly less rapidly than the Indian, hence it is none too early to put his picturesque past on record. Mr. Shinn takes the development of the great Comstock Lode of Nevada as typical of all the various phases of mining, from the scratching of the prospector to the stupendous feats of the engineer—as typical also of the leap into bonanza and the sinking into borrasca. The Mormons made the first notable efforts to settle the region that is now Nevada, but the growth of the mineral interests soon took it out of their control. In describing the placer mining and the first quartz prospecting that preceded the discovery of the Comstock Lode, Mr. Shinn introduces some of the restless pioneers that gave the mining camps of the period their rough and picturesque character. After the great discovery was made in 1859, came the rush across the Sierras which brought other choice spirits who figure in the early times of Virginia City. There were the industrious and unfortunate Grosh brothers; the bombastic, scheming, and ineffective Comstock who gave his name to the great Lode; drunken "Old Virginia," who christened Virginia City with an accidentally broken bottle of whisky; the wily gamblers and their often hard-working but reckless victims; enterprising traders and energetic teamsters; while the nationalities represented included Irishmen, Frenchmen, Germans, Canadians, Mexicans, Indians, and Jews. Mr. Shinn shows us the trails almost impassable with snow or mud along which a constant stream of pilgrims was toiling, the crowded public houses, the conglomeration of huts, tents, and dug-outs that made up a mining camp, and the abandoned pits and shafts which often entrapped straying animals and men. Passing from these primitive scenes, he shows us the various phases of the great industry which mining has become in our western country. He tells us how the crude methods of treating ores used by the early prospectors were succeeded by the *arrastra*, and this by the stamp mill; how some great mechanical problems were solved, such as timbering the wide Comstock Lode and bringing the water supply of Virgina City through a fourteen-mile flume and seven-mile siphon from Hobart Creek, and how the freighters, stage-drivers, and lumberers made money by letting the mines alone and devoting themselves to dependent industries. Mining litigation and stock speculation each have a chapter. We have an account of the days of the great bonanza, in which the operations of Mackay, Fair, Flood, O'Brien, and others are described. Perhaps the greatest engineering feat that figures in the story is the Sutro Tunnel—the "coyote hole," as contemptuous opposition termed it. In conclusion we are told what a present-day mine is like, both above and under ground, and what sort of men now make up its community. The volume is illustrated with many fittingly picturesque views.

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* The Story of the Mine. By Charles Howard Shinn. Illustrated. New York: D. Appleton & Co. Pp. 272, 12mo. Price, $1.50.

Judging from the account of Mr. *Loomis*, there is much enjoyment to be had incidentally from a scientific expedition to a strange land.* Merely passing over unfamiliar ground and observing its natural features, its inhabitants in their everyday aspect, and its ordinary sequence of events has its interest. But when the traveler is engaged in operations that are enough out of the common to appear somewhat weird to the non-scientific native and arouse his active curiosity, traits are brought out that do not appear to the ordinary visitor. A more realizing sense of the physical, political, and industrial condition of a strange land, too, is obtained when one has to accomplish a definite piece of work with the means that it affords than when one is concerned merely with passing through it. Personal equation is quite as much a factor in books of travel as in scientific observations. How much we prefer the writer who jots down the points that we take an interest in and answers the queries that arise in our minds as we follow his narrative! The reader with scientific tastes especially will enjoy Mr. Loomis's book. It describes the journey of the United States Scientific Expedition to West Africa in 1889-'90, the preparations for viewing the eclipse of the sun, and the return. After crossing the Atlantic, stops were made at the Azores, Cape Verd Islands, Sierra Leone, and on the Gold Coast before the destination of the expedition—Saint Paul de Loanda—was reached. On the return, Cape Town, the diamond mines of Kimberley, Saint Helena, Ascension, and Barbados were visited. The book gives abundant evidence that our author, in addition to his ability to record matters of exact observation, is not without a realizing sense of the beautiful and inspiring in Nature. The volume is handsomely printed, and is copiously illustrated with reproductions of photographs taken by members of the expedition.

Another careful study of a special field has been added to the Criminology Series.† The habitual criminal presents a much more serious problem than the occasional offender. Criminal habits, like most others, are formed in youth; hence any diminution that can be secured in the amount of juvenile crime will tend to reduce the most troublesome class of criminals. At present the author's study of statistics and other pertinent facts indicates that juvenile crime is increasing in both Europe and America. Its distribution agrees substantially with that of adult crime. While the bulk of juvenile criminals are boys, Mr. *Morrison* finds that "female offenders are rather more likely to descend into the ranks of habitual criminals than male offenders." He accounts for this largely from the fact that "females are, as a rule, later in being subjected to reformative discipline than males, with the ultimate result that this discipline is less effective when at last it has to be resorted to. It is therefore," he continues, "no real kindness to female children, when they exhibit symptoms of habitual delinquency, to allow these symptoms to develop unheeded." As to the kinds of crime committed by children, our author finds that petty theft and vagabondage are by far the most prevalent, mental and physical immaturity making it impossible for the young to be serious offenders against either person or property. It appears that most juvenile criminals are undersized and sickly, and many have a feeble intellect, bluntness of feeling, or unstable will. The operation of heredity has fastened these defects upon them, as a rule, so that they must be regarded as belonging to a decadent class. Besides the production of such disabilities the influence of parents often operates to rear young criminals through the conditions and associations of the home. From this examination of the production of juvenile crime our author turns to consider measures of repression. He finds that the plan of suspended sentence is very promising, especially with first offenders. A fine which may be paid in installments, or, in other words, a sentence to compulsory labor without imprisonment, also commends itself to him, but he has little faith in the efficacy of corporal punishment, in spite of the recent advocacy of it. Ordinary imprisonment, which he discusses in considerable detail, he also finds unsuitable for the young. The corrective institutions that have become numerous of late years seem to him to go to the root of the difficulty, as they aim to correct the defective physical and moral condition of the juvenile delinquent, and thus aid him to keep from future lapses. Mr. Morrison urges more intelligent supervision of inmates after their discharge from such institutions, which could be combined with conditional release before the expiration of the term of commitment. The book can not fail to be of service to all who have to deal with vicious tendencies in the young.

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* An Eclipse Party in Africa. By Eben J. Loomis. Illustrated. Boston: Roberts Bros. Pp. 218, 8vo. Price, $4.50.

† Juvenile Offenders. By W. Douglas Morrison. New York: D. Appleton & Co. Pp. 317, 12mo Price, $1.50.

It is a long step from the time when prehistoric man fashioned his rude weapons and battled with the rhinoceros and cave bear to the era of such a civilization as that of the Akkads, depicted for us by Mr. Anderson.* To these early Chaldeans Babylon and Assyria were indebted for their cuneiform characters and much of their culture. At Lippur, 3800 B. C., they possessed an extensive library. Some of their works on astronomy, being unearthed three thousand years later, proved sufficiently new to be studied by the Assyrians. In art they showed more skill than succeeding nations, and also made considerable progress in science, being acquainted with the sidereal year and reckoning the latitude of stars. They used the clepsydra, lever and pulley, lenses, and possibly telescopes, since tablets have been found apparently referring to the four moons of Jupiter.

It is almost incredible that the name and memory of a nation so extensive as to include all of Asia Minor and northern Syria, and powerful enough to be courted by Egypt in the time of the great Sesostris, could be blotted out of history for two thousand years. Yet this is the case in regard to the empire of Khita, and the story of her greatness has to be interpreted anew for us from the walls of Thebes and Egyptian temples. The Hittite inscriptions which are found in Asia Minor are as yet a riddle to scholars.

Other of the ancient civilizations happily did not fall into such oblivion, and concerning the distinctive features of each of these—Babylonia, Egypt, Phœnicia, the Hebrews, the Arabs, and ancient Persia—the author discourses ably and graphically.

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* The Story of Extinct Civilizations of the East. By Robert E. Anderson. New York: D. Appleton & Co. Pp. 213. Price, 40 cents.

GENERAL NOTICES.

The strong efforts now being made to develop a vehicle that shall propel itself, and the measure of success already achieved, promise the early attainment of an advance in locomotion as great as that afforded by the introduction of the safety type of bicycle. A good idea of the mechanical principles that are being employed in the solution of the problem may be gained from a translation of a recent book by a French engineer.* Of the four kinds of motor that have been applied to self-propelling vehicles—steam, electric, compressed air, and naphtha—the author has by far the most hopes of the last, and gives most space to this type in his book. His early chapters are devoted to a statement of the mechanics of steam and other gases, and he gives here also the theory of the electric motor. In describing the various systems of steam traction he gives first place to the Serpollet generator—the only generator of steam allowed for traffic in the large cities of France. Other steam motors that find place here are the Le Blant, De Dion & Bouton, Bollée, Filtz, Rowan, and Francq. Compressed-air autocars are represented by the Popp-Conti tramway and the Mékarski system. M. Farman is naturally most familiar with motor wagons of European origin, but he has inserted such accounts as were accessible to him of the American types. Among petroleum motors he ranks as king the one invented by the German Daimler, which is employed in the carriages of Panhard & Levassor, Peugeot, Gautier, and other builders. He gives a full description of this, and describes also the Roger car with the Benz motor, the Gladiator auto-cycles, the Duryea, Kane-Pennington, Tenting, and Delahaye cars, and several machines so far used only for agricultural or other industrial purposes. Electric carriages are represented by the Jeantaud, Morris & Salom, and Bogard. His concluding chapter deals with lubrication, tires, bearings, and other details. Over a hundred carefully drawn figures and diagrams illustrate the volume.

The notes which the reader will find in Miss *Merriam's* attractive volume were taken at Twin Oaks in southern California.* The author is a bird enthusiast who, before going to the Pacific coast, had known only the birds of New York and Massachusetts. "Every morning right after breakfast" she has her horse brought round, and together in silent sympathy she and Canello, the faithful patient little broncho, go the rounds of the valley, getting acquainted with the birds as they come from the south. Canello liked well to "watch birds in the high alfalfa under the sycamores, but when it came to standing still where the hot sun beat down through the brush and there was nothing to eat, his interest in ornithology flagged perceptibly." Then after dinner the author strolls through the trees to get a nearer view of the nests. The white egret, the green heron, the spotted sandpiper, the valley quail, are as fascinating to Miss Merriam as are the ants to Sir John Lubbock. Her description of all the birds is marked by a charming simplicity and by a beautiful use of English. She is in touch with Nature, with an eye for color, an ear atune to melody, and intellect clear and clean. It is a pity that we have not more such books as this and more such women as the authoress. We can imagine no better mental tonic than a ride on horseback in the early morning while the dew is on the grass, with the authoress as a chaperon and teacher of bird lore, for the weary city woman who needs to be lulled back to rest and get mental and physical health on the bosom of Mother Nature.

Prof. *Ramsay*, who was associated with Lord Rayleigh in the remarkable discovery of argon, has written a popular historical sketch of the several investigations that have given us our present knowledge as to what air is composed of.† He begins with the work of Robert Boyle, who published about 1650 his Memoirs for a General History of the Air, and proceeds with the less known labors of John Mayow and Stephen Hales.

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* Autocars. By D. Farman. New York: The Macmillan Co. Pp. 249, 12mo. Price, $1.50.

* A-Birding on a Bronco. By Florence A. Merriam. Boston: Houghton, Mifflin & Co. Price, $1.25.

† The Gases of the Atmosphere. By William Ramsay, F. R. S. London and New York: The Macmillan Co. Pp. 240, 12mo. Price, $2.

From some passages in their writings it would seem that each of these worthies came within a step or two of discovering all the main facts relating to the composition of the air, but each failed to look quite far enough in the right direction. Boyle, it appears, reasoned shrewdly from imperfect observations; Mayow died young; while Hales accumulated many and definite experimental facts, but lacked the ability to make use of them. All were hampered by the current errors of their time, among which the chief were the inability to distinguish one gas from another, lack of attention to gain or loss of weight, and above all erroneous ideas regarding combustion. Prof. Ramsay shows how the phlogistic theory, which came up about the end of Boyle's life, interfered with the researches of his successors—Black, Rutherford, Priestley, and Cavendish—until it was overthrown by Lavoisier. We are told something about the achievements of each of these men, and the account is made more interesting by including descriptions and portraits of the men themselves. After Cavendish little apparently remained to be done but to make more exact determinations of the constituents that had been found in the air. But in the course of some investigations in 1892 Lord Rayleigh noticed that nitrogen prepared from ammonia is somewhat lighter than atmospheric nitrogen. A research undertaken to find the reason for this difference brought out the existence of the inert argon. The circumstances of the discovery and the reasoning which led to it are set forth by Prof. Ramsay, who adds chapters giving the properties of argon and its position among the elements. The author has succeeded well in keeping his book within the comprehension of the persons without special scientific training for whom it was written.

Prof. Crockett's *Elements of Plane and Spherical Trigonometry*,* by a mathematician of note who is Professor of Mathematics and Astronomy in the Rensselaer Polytechnic Institute, has been prepared for the use of beginners in the study. Assuming that a high degree of proficiency can not be expected from such students, the author, not striving after original demonstrations, has limited himself to the selection of simple proofs of the formulas, to which geometrical proofs have in many cases been added. The definitions and explanations are admirably clear and concise. The numerical examples have been computed by the author, with special attention to correctness in the last decimal place. The tables are a special feature, are printed from differentiated type, and on paper of a different tint from the text, so as to make them easier to turn to. They give five places, while the angles in the examples are given to the nearest tenth of a minute. We find the book lucid and convenient.

The recent book of Prof. Keasbey * on the Nicaragua Canal urges frankly and emphatically the choice of the Nicaragua route for a canal across Central America, and the assumption by the United States of a dominant position in the political control of this water way. The author opens his discussion with a brief description and comparison of the ten or twelve more or less distinct routes that have been proposed, expressing the decided conviction that the Nicaragua and Panama routes are the only two worth considering, with the advantage on the side of the former. The greater part of the volume is devoted to a history of the attempts that have been made to construct canals in this region and to obtain political control of the territory through which they would pass. The record begins with the first Spanish explorations, and mentions canal projects of Spanish engineers formed before 1550. A chapter on the English freebooters opens an account of the struggle between England and Spain, lasting into the early part of the present century. The term from 1815 to 1865 Prof. Keasbey characterizes as a period of private initiative in canal projects. Two events in this division of his record which have an important bearing on the idea of cutting the American isthmus are the enunciation of the Monroe doctrine and the execution of the Clayton-Bulwer treaty. The time since 1865 he describes as a period of governmental activity in this matter, and he closes his chronicle of recent events by giving his view of the political, the technical, and the diplomatic situations of to-day with regard to the two chief routes. In his concluding chapters he argues for the construction of a canal as of transcendent importance to the economic development of America, and gives his reasons why the United States should control the passage. The volume is carefully indexed and contains four maps.

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* Elements of Plane and Spherical Trigonometry, with Tables. By C. W. Crockett. American Book Company. Pp. 311. Price, $1.25.

* The Nicaragua Canal and the Monroe Doctrine. By Lindley Miller Keasbey. New York: G. P. Putnam's Sons. Pp. 622, 8vo. Price, $3.50.

Among the papers accompanying the *Report of the United States Commissioner of Education for 1894–'95* are two dealing with important subjects connected with the educational system of Great Britain. One of these is the question of religious instruction in the free schools, and the other is the organization of secondary education as shown by the report of a royal commission. The legal aspects of the Manitoba school case are given in another contribution. Foreign matters of interest treated in other papers are the university education of women in England, the educational status of women in various countries, and English teaching on the history of the American Revolution. Of domestic interest are the chapters on teachers' pensions, Chautauqua education, and early educational history in the United States.

The book on *Alternating Currents and Alternating Current Machinery*, by *Profs. Dugald C* and *John P. Jackson*, forms Volume II of their text-book on Electromagnetism and the Construction of Dynamos (Macmillan, $3.50). The authors have followed in it methods that have been found advantageous in teaching other branches of engineering. The volume is designed to present the fundamental phenomena of alternating currents as met with in engineering practice, and to point out their controlling principles and applications. Descriptions and illustrations of commercial machinery are not included *per se*, though where practical data may be useful in illustrating deductions in the text they are copiously used. For the fuller information of the reader, a large number of references are given in footnotes. In the chapters on polyphase currents the authors could not hope to supply a list of references that would remain long adequate, as material of overshadowing importance is being constantly published. Descriptions of experiments having only historical interest have been carefully excluded. In the use of mathematics the authors have sought to avoid presenting unnecessary formulas on the one hand, or giving results without reasons on the other. Numerous original demonstrations of the standard formulas have been introduced and a few additions have been made to the nomenclature. The volume contains over three hundred diagrams and other figures, and is adequately indexed.

In a neatly printed little pamphlet *H. Edwin Lewis* has discussed *The Philosophy of Sex* scientifically, delicately, and impressively. His chapter on Reproduction and the Origin of Sex and that on the Nature and Relation of Sex lead up to an earnest appeal for sexual purity, which can not fail to help well-intentioned persons who are weak or thoughtless or who do not know where to turn for guidance. (Vermont Medical Publishing Co., Burlington, 35 cents.)

Much out of the common run of text-books is *Number and its Algebra*, by *Arthur Lefevre* (Heath, $1.25). It deals with the theory of numerical operations, and is designed to be introductory to a collegiate course in algebra. It thus bears a similar relation to algebra that the chapters on chemical philosophy in books on chemistry bear to their main subject. The mathematical operations whose natures are explained range from counting up to work with radical surds, undetermined coefficients, roots of integral and quadratic equations, radix fractions, and functions. The several chapters are based on lectures which the author has given for a number of years to his university students with the especial design of aiding the large part of them who were preparing to teach, hence pedagogical applications will be found throughout the book. "Plainly the first step," says the author, "to the understanding of the algebra of number is to understand the nature and laws of number. It is hoped that these lectures have been a fairly adequate guide and stimulus to this step. After mastering what may be called the vocabulary of the language (proficiency in this matter has been assumed), the next step is to grasp the idea of algebraic *form*. In the study of algebra this should be the main standpoint. It is only by following out the problems which arise in a systematic study of algebraic form that the modern developments of pure algebra, or its applications to geometry, can be rightly comprehended."

From the Department of Agriculture we have received *Insects affecting Domestic Animals*, an account of the species of importance in North America, by *Herbert Osborne*, Professor of Zoölogy and Entomology, Iowa Agricultural College. This report gives, in about three hundred pages, a description of all the parasites the stock raiser has to contend with. After an introductory chapter on parasites in general, the following six chapters deal with the various pests in detail. The seventh chapter tells of remedies and preventive treatment. Classified lists and a bibliography complete the pamphlet. The report represents the result of investigations carried on at intervals since 1885. In the words of L. O. Howard, entomologist to the department, it "will form an excellent textbook of the subject, and is a work which should be in the hands of all stock raisers." It is fully illustrated by plates and cuts.

Observations on the Fur Seals of the Pribiloff Islands—Preliminary Report by *David Starr Jordan*, Commissioner in charge of Fur-seal Investigations for 1896—brings some interresting data as to the condition and the fishery of seals on a little cluster of islands in the Bering Sea. Under different headings it describes the islands, the rookeries, habits and breeding of the seal, and the different modes of killing, and their effects. A number of statistical tables put these difficult investigations on a scientifically accurate basis; and a map appended to the pamphlet locates the routes of the seal under way.

The February number of the *Expositor*, a theological magazine, opens with a rather searching criticism of Ian Maclaren's The Mind of the Master, by the Lord Bishop of Derry and Raphoe. He points out what to him seem numerous errors of interpretation of the Gospels; and from his Anglican point of view the Rev. John Watson's broad if not exactly new proposition—that of substituting the Sermon on the Mount for the creeds of Christendom—would mean a giving over of Christianity altogether. Among the other papers of interest to lay readers may be mentioned Christian Perfection, by the Rev. Joseph Agar Beet; John's View of the Sabbath Rest, by the Rev. George Matheson; and The Priest of Penitence, by the Rev. E. N. Bennett. Among the reviews a large space is given to books on social topics. Two of these reviews are by Prof. Richard T. Ely, and one by Prof. William Adams Brown.

The *Analytic Keys to the Genera and Species of North American Mosses*, prepared by *Charles R. Barnes*, and published by the University of Wisconsin, is a new edition and enlargement of a Key to Genera published for free distribution in 1886, and Keys to Species published in 1890, and is intended to serve the same purpose as they—of furnishing a convenience to students rather than to present a critical study of North American mosses. It includes, therefore, a very large number of new species that have been described since 1890. For the benefit of amateurs, though specialists may not need them, collected descriptions are appended of all species not found in Lesquereux and James's Manual. The attempt is made to include all the species reported or described as belonging to our flora, unless later study of the genus has shown the addition to be untenable; and such special studies are cited in the Keys. Pains have been taken to include as many of the barren and insufficiently described species as possible, in order that they may be recognized, if they exist, or may be referred to their proper place. Varieties are not discriminated, but inquiry into the subject is suggested. The work of preparing this edition has been largely done by Mr. de F. Heald, with the co-operation of the author.

Prof. *G. Frederick Wright's* comprehensive and fully illustrated account of *The Ice Age in North America*, which first appeared in 1889, reached its fourth edition in 1896 (Appletons, $5). Detailed work upon the glaciated areas has been going on actively since the third edition came out, but Dr. Wright finds no occasion to modify materially his original statements, either of fact or of theory. In his preface to the new issue he gives a list of papers in which the results of this recent work have been embodied, accompanying it with notes on the contents of many of the papers. He inserts also a map prepared by Mr. Warren Upham showing the three stages in which Prof. T. C. Chamberlin has classified the glacial formations of North America and the later lines of recession toward the northeast. Prof. Wright sees many open questions in glacial geology "inviting the continued attention of local observers and promising to all interesting and important discoveries."

The *Report of the New York State Board of Charities for 1895* gives evidence of a year of active work. The report proper is accompanied by a large number of special reports of inspections by one or more members of the board, made to ascertain the general condition of the several hospitals, almshouses, children's homes, and other charitable institutions in the State or to investigate alleged abuses. Institutions found to be in good condition are cordially praised, and defects are unhesitatingly condemned. The ordinary operations of the institutions under the supervision of the board are fully shown in tables.

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Fragments of Science.

Horticultural Extension Schools.—Experiments in methods of extension teaching as applied to horticulture have been made by Prof. L. H. Bailey in connection with the Cornell University Experiment Station, through itinerant or local experiment, readable expository bulletins, the itinerant horticultural school, elementary instruction in rural schools, and correspondence and reading courses. The greatest good as yet accomplished seems to have come through the bulletins. These have taken the form of surveys of the status of certain industries, with especial attention given to floriculture and ornamental gardening. Besides the consecutive teaching of horticultural schools, Nature study and object lessons were taught in a series of schools, with the object, besides imparting specific horticultural information, of awakening closeness of observation and careful reasoning from it on the part of the attendants. Observation lessons constituted one of the most useful exercises in connection with these schools. Small objects, like leaves or roots or flowers or seeds, were put in the hands of all the attendants, and after they had examined them for a few minutes the instructor began to ask questions concerning them. This exercise drilled every participant in observation and in drawing proper inferences from what he saw, and was productive of the greatest interest and good. Such schools serve better as the culmination of a series of extension efforts than as a primary or preliminary means of awakening the rural communities. Another series of lessons had the determination of the manner in which pupils could be reached by means of object-lesson teaching, and the amount of interest they would be likely to manifest in agricultural matters in case it should ever be found desirable to introduce such teaching as a part of the distinct school work. The conclusion is drawn by Prof. Bailey, from this experimental work, that the farmers, as a whole, are willing and anxious for education. They are difficult to reach, because they have not been well taught, not because they are unwilling to learn.

Effect of Veils on Eyesight.—In experimenting upon the effect of the wearing of veils upon the eyesight, Dr. Casey A. Wood, of Chicago, selected a dozen typical specimens of veils and applied the ordinary tests of ability to read while wearing them. These tests showed that every description of veil affects more or less the ability to see distinctly, both in the distance and near at hand. The most objectionable kind is the dotted veil. Other things being equal, vision is interfered with in direct proportion to the number of meshes per square inch. The texture of the veil plays an important part in the matter. When the sides of the mesh are single, compact threads, the eye is much less embarrassed than when double threads are employed. The least objectionable veil is without dots, sprays, or other figures, but with large, regular meshes made with single, compact threads. Eye troubles do not necessarily result from wearing veils, for the healthy eye is as able as any other part of the body to resist the strain they impose upon it. But weak eyes are hurt by them, and prudence should teach not to strain healthy eyes too much.

Domestication of the Egret.—A resolution was adopted at the International Zoölogical Congress held in Leyden in 1895, favoring measures for the preservation and domestication of the egret. Under present conditions the bird, so highly prized for its plumes, is undergoing rapid extermination. M. J. Forest, the author of the Leyden resolution, is confident that the domestication of the egret herons will be found as practicable as that of the ostrich has proved to be. The little egret, or garzette, in particular, has already shown itself quite susceptible to the taming process. In a heronry established at Tunis in 1873, a flock of thirty young birds has increased to about four hundred. The establishment contains a pool and trees, and cost less than twenty-eight hundred dollars. It was stocked in the beginning with captured wild birds, whose disposition and capacity to breed did not seem to be affected by their captivity. The proprietor represents that he gets six or seven dollars a year from each bird, plucking the plumes twice a year, in June and October, besides the increase of the flock. The capacity of the large egret for domestication is not so well established; but a specimen of this bird, which had been captured wild and then tamed, was sent to the *Jardin d'Acclimatation* in Paris from Guiana in 1853; and several travelers—Paul Marcoy, Thouar, the lamented Crévaux, and Ehrenreich—mention having seen in Paraguay and along the Amazon numerous domesticated birds, herons and grebes among them, living in the Indian villages on whatever they could find to eat there. Herons bearing ash-gray plumes are kept in some of the larger houses of Bagdad.

Inventing a Match.—The credit of the invention of chemical matches is claimed for various persons in different countries—for Friedrich Kamrer in Germany, Roemer and Preschel in Austria, Ironvi and Moldenhauer in Hungary, Ivan Worstakoff in Russia, Watt and Isaac Holden in England, and Charles Lauria in France. The one thing agreed upon is the date—1833. For Lauria the claim is made by M. Jacques Boyer that he thought about the matter in 1827, when he saw Gay-Lussac's hydrogen tinder box at Lyons in 1827, and had made a practical match before 1833. Immediately after witnessing Gay-Lussac's experiment he began to look for a fulminating powder which would enable him to realize the dream he had conceived, and while still in this search saw his professor of chemistry, Nicollet, produce the detonation of powdered sulphur and chlorate of potash. Then he thought that if he could incorporate phosphorus with this mixture he might produce the blaze he wanted. He had no apparatus but a few sticks of sulphur-tipped pine and some glass tubes. He had got some parcels of sulphur and chlorate from the college laboratory at Dôle, and having obtained a little phosphorus from a pharmacy, he proceeded to melt his mixture. As he was inexperienced and awkward at the work, he suffered a number of accidents, in which his bed curtains proved readier to take fire than his matches. At last he dipped the end of one of his sulphured sticks into the chlorate slightly warmed. Some of the chlorate adhered, and, rubbing his half-finished match on the wall where a trace of phosphorus had found its way, the stick blazed up at once. Lauria called his comrades and the principal of the college to witness his achievement, and enjoyed a kind of triumph. He made a few improvements in his invention, added a little gum arabic to his mixture to make it more adhesive, and had what is in principle the match of to-day. His fellow-students amused themselves with the matches, Prof. Puttenay made some for his own use, and they found their way into a *café* at Dôle, but the effort to find a more general market for them did not succeed.

Young Animals at School.—A new theory of the sports of young animals put forth by Prof. Groos, of the University of Giessen, holds that they are a preparation for after-life, for the adaptation of the faculties for the sterner purposes of maturity, and are in effect dependent upon the necessity of modifying instincts. The higher an animal may be in the scale of life, the author assumes, the more varied become its relations to surrounding things and the less suited to varying circumstances becomes a mechanical and rigid instinct. If, however, there is a period of youth during which inherited instincts may be used merely as a vehicle for redundant energy, an opportunity is afforded for modification and alteration of the rigid system. The instinct of a creature with practically no period of youth, as with insects, must be complete and ready for use. The mammal or bird, however, passes through a period of youth "during which it has no immediate duties to perform and is cared for by its parents. In this time it plays with its instincts, learns to fly or to run and jump, to recognize its kind, to distinguish between the palatable and unpalatable, to make and understand call notes or cries of alarm; in a thousand ways to suit each occasion with its action and deserve a place in the hierarchy of intelligent beings." The games and sports earliest to appear in animals and most universal are classed by Prof. Groos as those of experiment and curiosity. "Young creatures play with everything that attracts their attention. They try their teeth or their claws on every available object. They taste and smell, rush and tumble about, collect in heaps or scatter everything they are able to reach, and, indeed, make attempts on the unattainable. The greater the intelligence of the adult animal the more surprisingly the young animal treats its surroundings in the spirit of an empirical philosopher. A young monkey observed by a sister of the late Prof. Romanes discovered for itself that the handle of a hearth brush was screwed into a socket. It succeeded in unscrewing the handle with ease, and after long experiments discovered that only one end twisted in a particular direction would fit into the socket. Another young monkey, chained just beyond the reach of a fire, found out how to tear strips from a newspaper and roll them up into tapers sufficiently long to reach the flames. By some such fertile employment of curiosity the professor thinks that the ancestors of man may have gained their mastery over fire." Skill in flying is attained by considerable practice, and "in mammals the exercises of the young bear a definite relation to adult habit. Mountain-living creatures, like kids and chamois, continually practice standing jumps, springing vertically into the air. . . . Gazelles, on the other hand, which have to jump watercourses and gullies on the Veldt, confine their youthful enthusiasm to practice of the running jump. Similarly the play of tiger cubs with balls or with the tail of their mother, and the wrestling and mimic combats of other carnivorous young, all exhibit an instinctive bias by which the restless zeal of youth is disciplined for the real purposes of maturity."

Seals and their Pups.—A fur seal has none of the altruistic instincts of some other animals, for it will never feed any pup but her own. Not a very affectionate mother at best, she yet unerringly knows her nursling's voice, and he in turn learns to find her. When they meet and recognize each other at meal time, it is easy to see that they belong together. Her duty done, however, she lets it shift for itself till the next feeding time. She instantly knows any little hungry intruder that is stealing up to her to get a meal on the sly. She cuffs and bites, until the starveling, intimidated, slinks away to die. These orphaned younglings are the fruit of the indiscriminate "pelagic" sealing. Their mother being killed, and they unable to obtain another nurse, they perish by the thousands. A United States report estimates the number for 1896 at 20,331.

The Last Resting Place of Pasteur.—On December 26, 1896, the remains of Pasteur were borne to their final resting place, a crypt at the Pasteur Institute. On the stone is inscribed a sentence from his reception speech at the Academy: "Heureux celui qui porte en soi un dieu, un idéal de beauté, et qui lui obéit—idéal de l'art, idéal de la science, idéal de la patrie, idéal des vertus de l'évangile" ("Happy he who bears within him a god, an ideal of beauty, and follows it—an ideal of art, an ideal of science, an ideal of patriotism, an ideal of the Christian virtues"). Many men of science and thinkers of note, both French and foreign, were present, and deputations and wreaths were sent by scientific societies. A service at Notre Dame, where the remains had been reposing for the last fifteen months, was followed by the ceremonies at the crypt. M. J. B. Pasteur said to the council of the institute, in behalf of the family, "I intrust to you this tomb which we have raised to our father in this institute which he loved so dearly." Addresses were delivered by M. Rambaud, Minister of Education, and M. Baudin, President of the Municipality, and an address by M. Legouvé was read by M. Gaston Boissier.

Bachelor Seals.—The young male seals, commonly called "bachelors," are very much like the females in size and color. During the breeding season they are not permitted by the bulls to enter the rookeries, hence they herd together separately on the so-called "hauling grounds." Unlike their seniors, who in the "harems" are busy founding families, these young bachelors have no fixed place of abode, but range at will over a large area of ground, usually sand beaches near the rookeries. Known also as "killable" seals, they are driven from their haunts and killed with clubs at about three years of age, the time when their fur is at its best. Small four-year-olds and large two-year-olds, being about the same size as the bachelors, are also hunted. Among these herds may sometimes be found bulls from four to six years old, who, being too cowardly to assert themselves in the harems, are forced to keep company with these youngsters. Another mode of hunting them is called "pelagic sealing," which means killing them in the open sea with firearms, or with the spear and club. In order to digest their food, they lie sleeping on the surface of the water, and the hunter finds it easy enough to steal up in his boat and spear the defenseless animal. This is really wholesale slaughter, for the hunter indiscriminately kills whatever lies in his way, even the nursing mothers, thus leaving the pups to die of starvation.

Nationality and Scenery.—In the introduction to an article in the *Deutsche Rundschau* descriptive of the German landscape, Herr Friedrich Ratzel shows by a few well-directed allusions how the intrinsic character of the scenery of a region, even in its apparently most natural features, is affected by the nationality that occupies it, and reflects the character of that nationality. The allusions are local, but the principle they illustrate is general. A country with such a history as Germany's can have no purely natural landscape. The people and their land are the resultant of a long material development. When the Romans knew Germany—a barbarian region with few inhabitants—the works of man were less in evidence, and Nature prevailed. The effects of cultivation have worked in two principal directions: First, the woods are cleared up, the water is confined within limits, the habitations of men are multiplied and enlarged and made more durable, and new plants and animals are brought in. Then uncontemplated changes step in, which proceed of themselves from the works of cultivation. With the drying of the soil the climate is modified. The introduction of new plants and animals imposes new features upon the conditions of life. Where before only stretches of heath, moor, and swamp formed natural openings in the predominant forest, extensive woodless regions arise through the labors of man, from which the shade-loving plants and animals that were protected by the forest gloom disappear, and other inhabitants are at home in the cultivated fields. The variations in the particular shaping of these changes are more especially marked where the boundaries run through mountain regions. In the Saxon Erzgebirge the forests have lost all their wildness, and plantations of firs and oaks grow in regular order, all nearly of a height, with no trees towering into prominence, and the mountain has the trimmed and symmetrical appearance of a nursery. The brooks are tamed, dammed, and made to earn their right to be as the servants of the mills. Passing over the mountains and going down the Bohemian side, we are in the woods again, with the valleys free and irregular, and the brooks running according to their own will. The contrast is seen again, but less marked, in going up from Bohemia and down into Bavaria. Within Germany itself the garden-tilled plots near the industrial centers and the little rectangular holdings of the south-western and middle districts, each distinctly marked off from its neighbor, and making the whole look like a party-colored checkerboard, impress one very differently from the immense fields devoted to single crops and the commodious barns of the north. Other differences may be seen on the upper Rhine, where the inhabitants of both sides were originally the same people, but have been subjected to different influences in the course of their history. The French have made their marks all over the Alsatian territory and in the towns of quite another character from the native German aspects of the Baden side.

A Survival of Torture.—Although the practice of torture to extract evidence was formally abolished in 1789, the spirit of the Inquisition has not yet died out in the continental countries of Europe. This is shown now and again in criminal cases. But not the convicts only are treated with the utmost severity. The mere suspicion of crime is enough to make a man's life miserable. He practically loses all civil rights, and finds himself at the mercy of an interrogating magistrate with full power to extract a confession, by moral suasion if possible, by more forcible means if need be. Subjected to a prolonged and tortuous system of cross-questioning, the accused often completely break down mentally and confess at random whatever has been suggested to them, much in the manner of the trials for witchcraft in our own Puritan New England. A case creating quite a sensation in Paris some thirty years ago was that of a woman who under this fire of interrogation admitted having killed her newborn infant, two months even before the birth of the child. If the culprits are suspected of obstinacy in answering, all sorts of expedients are used to make them more compliant, such as making their diet unpalatable, or altogether withholding food and water, and penning up in close, dark quarters.

Prof. Cannizzaro's Jubilee.—The seventieth birthday of Prof. Stanislas Cannizzaro was celebrated on November 21, 1896, amid a concourse of the most distinguished scientists and other men of note of Rome. He was presented with a gold medal and a bust of himself in bronze, and received innumerable letters, telegrams, addresses, and *pergamenas* from the leading scientific societies of the world. Prof. Semeraro, Rector Magnificus of the Roman University, said in his address: "His greatest glory lies in the fact that most of the professors now teaching in Italian universities have been his pupils. The pressure of business as vice-president of the Senate and member of the Superior Council of Public Instruction, and many others, never were pretexts to him for overlooking the modest duty of a teacher." Hon. Galimberti, presenting him with the Grand Cordon of the Crown of Italy, said: "Your name is worthy of being joined with those of Galileo, Torricelli, Volta, and Galvani. To Emanuel Kant, who, in his absolute sentence, considered chemistry as a union of empirical knowledge, you replied half a century ago, pronouncing among the confusion of doctrines immovable ideas and true laws that render chemistry an exact science, for it lies now on mathematical truth." Cannizzaro replied in an interesting speech. Referring to the combination of the functions of teacher and investigator, he said: "Had I not been a teacher, my publications would not have appeared, and I should have continued to disseminate science of new carbon compounds. I bring here Lord Kelvin's example, who, in his last jubilee, spoke of the utility he had found by the continued conferences with his pupils."

Some Antipathies of Animals.—A number of very curious featuries in the antipathies of animals are pointed out in an article on the subject in the London Spectator. There are permanent hereditary antipathies, like those of cats against dogs, and purely instinctive, inexplicable antipathies, which are naturally the least common, but of which there are marked and definite examples. Of such is the disgust which the camel excites in horses. These animals "have been associated for centuries in the common service of man, and early training makes the horse acquiesce in the proximity of the creature which disgusts him. Otherwise, it is far more difficult to accustom horses to work with camels than with elephants, precisely because the repugnance is a natural antipathy and not a reasoned fear." They get used to the sight of an elephant, but the smell of a camel disgusts and frightens them. English horses that have never seen a camel refuse to approach ground where they have stood. For this reason a traveling menagerie was recently refused permission to encamp on a village green, although the people would have been glad to see the show, but because the presence of the camels would interfere with the customary use of the place for a market, by engendering difficulties when the next attempt should be made to drive horses upon it. Yet, at a performance of two bears in London, one of the horses of a four-in-hand almost touched one of them, without himself or any of the team showing any nervousness over the matter. The hatred of cattle for dogs is supposed to have been inherited from the days when their calves were constantly killed by wolves or wild dogs. But "why the horse not only does not share this antipathy, but, on the contrary, loves a dog, it is difficult to explain." The dislike of the cat family for dogs likewise probably dates from the time when the wild dogs hunted and destroyed their whelps. "There is much probability in this conjecture, for it is the dog, and not the wolf, which the tiger so intensely dislikes, and it is only the packs of wild dogs, not wolves, which would venture to kill a cub. Leopards, which naturally live in branches of trees, simply look on dogs as a favorite article of food; and the puma of the pampas, which inhabits a country where the wild dog is unknown, is also a great dog-killer. The dogs, on their part, seem quite aware of the difference of view on the part of the various cats; they will mob a tiger and hunt all tiger-cats. But they all seem to fear the leopard, and by nature to fear the puma, though in North America they can be trained to hunt it. It was recently noticed that a large dog, which found its way to a point opposite the outdoor cages of the lion-house at the Zoo, crept underneath a seat as soon as the puma caught sight of it, and exhibited signs of the utmost nervousness and fear." The antipathies of most animals find a climax "in the common and intense horror of the poisonous snake."

MINOR PARAGRAPHS.

The Municipal Administration Committee of the Reform Club of the City of New York has secured Mr. Robert C. Brooks as its secretary, who has established his office at the University Settlement House, 26 Delancey Street; has begun the collection of a working library, which is rapidly growing; and has practically completed a bibliography of Municipal Administration, of twenty-five hundred manuscript pages, comprising a subject index and another list, arranged alphabetically and containing nine thousand entries referring to thirty four hundred articles in American, English, French, German, Italian, and Spanish publications, with the names of twelve hundred writers. It has more recently begun the issue of a quarterly magazine called Municipal Affairs, the first number of which contains the bibliography. It is working earnestly to enlist those who are willing to aid in propaganda work—chiefly by holding meetings, at which questions of municipal polity are discussed by competent speakers.

The importance is insisted upon by Thomas A. Williams, in a paper on the Grasses and Forage Plants of the Dakotas, of making every effort to preserve the native grasses. They are naturally adapted to the conditions that prevail in the region, and it is very improbable that introduced forms can be had to take their places satisfactorily for many years to come. Climatal evidences are abundant to prove that some of the native forms will flourish under conditions that would kill the common cultivated ones; and the prolonged dry weather of the later summer, which would be destructive to cultivated species, simply cures these native ones on the ground, so that cattle can forage on them in winter as if they were hay. The importance of these grasses is illustrated by the immense shipments from the Dakotas of stock which have had no other feed than that growing naturally on the prairies. Many of the most valuable of these grasses are much benefited by judicious irrigation, even though it be only slight.

An expedition is fitting out by the American Museum of Natural History, with the aid of Mr. Morris K. Jesup, for the systematic study of the peoples inhabiting the coasts of the North Pacific Ocean between the Amoor River in Asia and the Columbia River in America. The exploration is to be prosecuted during six years, and to include both the Asiatic and the American coasts. Its primary object is to search for light concerning the origin of the American race and its relations to the races of the Old World, concerning which, in the absence of all definite knowledge at present, a confusion of opinions exists. The characteristics of the American races have been studied to a considerable extent by the Russian missionary Veniaminoff, Dall, and others, in Alaska and the Aleutian Islands; Murdoch among the Eskimos of Point Barrow, and Boas under the auspices of the British Association in British Columbia; but, as Dr. Boas observes, very much remains to be done in those districts; while of the corresponding region in Asia, notwithstanding the few investigations that have been published, the types of man, languages, customs, and mythology are practically unknown.

Among the interesting jubilees celebrated during 1896 was that of the York Retreat in England. In 1792 William Tuke, a member of the Society of Friends, became convinced that the methods of treatment of the insane which prevailed at that time were unnecessarily harsh; they were treated more like wild beasts than as human beings. William Tuke therefore conceived the idea of founding an institution where sufferers from mental disease could be treated in a manner more in accordance with humanity and with sound therapeutic principles. The necessary support was after a time obtained, and the "Retreat" was opened in 1796. It was the first institution in England where the insane were treated in a humane and rational manner.

Mr. B. N. Brough affirms, in a lecture on deep mining, that the greatest depth yet reached in mines is 4,900 feet at the Red Jacket shaft of the Calumet and Hecla mine, in the Lake Superior district. The Tamarack mine, in the same district, 4,450 feet, is the only other mine going below 4,000 feet in depth. Four mines in Germany, two in Belgium, and one in Austria-Hungary are between 3,500 and 4,000 feet deep. The deepest British mine is the Pendleton, near Manchester, 3,474 feet deep; and the deepest in Scotland is the Niddrie, at Porto Bello, 2,010 feet. The products of the mines are now lifted with ropes of crucible steel wire, of which a flat rope is mentioned weighing only 8·2 pounds per foot, which had a tensile strength of eighty-nine tons per square foot, and lasted twelve months while used for raising loads of eleven tons from a depth of 3,117 feet. At the deep mines of Calumet the cage, carrying six tons, was lifted at the rate of a mile in a minute and a half. In England the speed has been as great as fifty-seven miles an hour. The increased cost of sinking these deep mines is believed not to be very appreciable where the output is considerable. At Tamarack the cost of increasing depth was more than compensated by the increased output and improved machinery.

The most important events in last year's history of the astronomical observatory of Harvard College were the erection of the Bruce photographic telescope in Peru, and the establishment of a series of circulars, which furnish a prompt means of announcing discoveries. Twenty-five hundred and eight photographs were taken with the eight-inch Draper telescope, and twenty-seven hundred and seventy in Peru with the eight-inch Bache telescope; and "there is probably no star brighter than the thirteenth magnitude in any part of the sky from the north to the south pole that does not appear on one or more of these plates." The attempt is made to photograph all the regions in which variables are discovered at least once a month. In Mrs. Fleming's examinations of the spectra photographed, a large number of objects having peculiar spectra have been discovered. Two new stars have been found in the constellations Carina and Centaurus. The photographs of one of the new variable stars show a very peculiar spectrum and changes of light unlike those of any star hitherto discovered. Meteorological observations were continued at La Joya, 4,150 feet above the sea; Arequipa, 8,060 feet; Alto de los Huesos, 13,300 feet; Mont Blanc station on El Misti, 15,600 feet; El Misti, 19,200 feet; and Cuzco, 11,000 feet.

A work by M. Meguin on the Bacteria of Dead Bodies is reviewed in a recent issue of the British Medical Journal: "As a result of this work it is now possible to determine in a most accurate manner the time of death of an individual by an examination of the cadaver and of the successive generations of insects which are found inhabiting it. The author has established the important fact that these successive inhabitants always arrive in the same order from the time of death to that of complete disintegration of the body. . . . The importance of this work from a medico-legal point of view can not be overestimated, and that it is capable of practical application the author shows by a number of interesting cases."

NOTES.

The presidents of sections of the British Association, nominated for the coming meeting at Toronto, are: Section A, Mathematical and Physical Science, Prof. A. R. Forsyth, F. R. S.; B, Chemistry, Prof. W. Ramsay, F. R. S; C, Geology, Dr. G. M. Dawson, C. M. G. F. R. S.; D, Zoölogy, Prof. L. C. Miall, F. R. S.; E, Geography, Mr. J. Scott Keltie; F. Economic Science and Statistics, Prof. E. C. K. Gonner; G, Mechanical Science, Mr. G. F. Deacon; H, Anthropology, Prof. Sir W. Turner, F. R. S.; I, Physiology, Prof. M. Foster, Sec. R. S.; K, Botany, Prof. H. Marshall Ward, F. R. S. The evening discourses will be delivered by Prof. Roberts-Austen, C. B., F. R. S., and Prof. John Milne, F. R. S.

A banquet was recently given by scientific men of France to Mme. Clémence Royer in celebration of her seventieth birthday. She is eminent in the study of the mental traits of animals; translated Darwin's work into French; is an advocate of evolution; and is the author of articles on the Mental Faculties of Monkeys, and Animal Arithmetic, which were published in the Popular Science Monthly several years ago.

Mr. Herbert Spencer was offered the honorary degree of Doctor of Science by the authorities of the University of Cambridge, but, adhering to his uniform practice, from which he says he can not depart, has declined it.

The Emperor of Germany has just decorated Dr. Roux, the discoverer, with Dr. Behring, of the vaccine against diphtheria. Two years ago Pasteur refused a similar honor, for reasons of his own. Dr. Roux, although the intimate friend and successor of the great scientist, did not allow his loyalty toward his master to stand in the way of accepting this mark of recognition from the foreign potentate.

The Paris Academy of Sciences has awarded an Arago medal to Lord Kelvin, on the occasion of the jubilee of his professorship in Glasgow University. In conferring it, M. Cornu, the president, touching on the testimonies coming from all parts of the world, said: "Nothing is more consoling for the future than the spectacle of these honors rendered by delegates of all nations to great men of science like Kelvin and Pasteur, who so worthily represent science in its loftiest and at the same time most beneficent aspect."

According to the Times, the Government intends to introduce next session a bill to promote free vaccination throughout England, following continental methods. A small committee, headed by Dr. Thorne Thorne, of the Local Government Board, has investigated these methods in Paris at the Institut Vaccinal and the Académie de Médecine, and in Brussels at the École de Médecine, and at Dr. Janssen's vaccination department under the municipality of the city. They intend also to investigate the modes of procedure in Germany.

Edward D. Cope, Professor of Zoölogy and Comparative Anatomy in the School of Biology at the University of Pennsylvania, died in his museum in Philadelphia, April 12th, aged about fifty-seven years. The illness which took him away was one from which he had been a sufferer for many years. He delivered his last lecture at the university two weeks before his death, had been able to attend to some scientific work the Wednesday previous, and his condition had been alarming only for four days. A sketch of his life and work to that time, and a portrait, were given in the Popular Science Monthly for May, 1881. He was presiding officer of the Biological Section of the American Association in 1884, and was president of the Buffalo meeting of the association in 1896. His later publications since our sketch have been: Origin of Man and other Vertebrates, 1885; Tertiary Vertebrates, 1885; The Energy of Life Evolution, and how it has Acted, 1885; The Origin of the Fittest, 1886; and The Primary Factors of Organic Evolution, 1896. Prof. Cope was most eminent in paleontology, but was distinguished in many other branches of biology.

Prof. James Joseph Sylvester, of the University of Oxford, died in London, March 15th, in the eighty-third year of his age. He was born in London, September 3, 1814, was graduated from St. John's College, Cambridge, in 1837, as second wrangler, was appointed Professor of Natural Philosophy in the University of London, and in 1841 became a professor in the University of Virginia. He did not, however, remain there quite a year, but returned to London, found employment as an actuary and conveyancer, and was called to the bar in 1850. He was appointed Professor of Mathematics in the Royal Military Academy at Woolwich, retired from this position in 1862, and was appointed Professor of Mathematics in Johns Hopkins

University. Here his abilities seemed for the first time to have free scope, and his career was brilliant. He established the American Journal of Mathematics, through which and by his personal teaching and influence he gave a great vitality to mathematical study in this country which still pervades it. In 1883 he was elected Savillian Professor of Mathematics in the University of Oxford, where he repeated the success he had achieved at Johns Hopkins and exerted as potent an influence.

Prof. Henry Drummond, who died in March, 1897, was best known to scientific and the religious circles by his book on Natural Law in the Spiritual World, which touched upon points in which both were interested. His later volume, a collection of Lowell Lectures, on the Ascent of Man, also went into both fields. These books, however, well intentioned and readable as they were, were subjected to adverse criticism from both sides. In 1879 he accompanied Sir Archibald Geikie in a geological tour in the Rocky Mountains, and afterward visited the Scotch mission stations in East South Africa. A result of this visit was a very interesting book on Tropical Africa.

Mr. Sidney Walker, fellow of the Royal Astronomical Society since 1873, whose death was recently announced, read several papers on nebulæ before the society, and contributed an article on the distribution of the stars in the southern hemisphere to the Monthly Notices for 1878. He made two very fine maps showing the distribution of the nebulæ and clusters in Dr. Dreyer's catalogue.

M. Antoine T. d'Abbadie, a member of the French Academy of Science since 1857, in the Section of Geography and Navigation, died in Paris, after a long illness, March 20th, in his eighty-seventh year. His scientific work included exploration, astronomy, geodesy, physics, and numismatics. In 1893 he bequeathed to the Academy, reserving a life interest to his wife, the château of Abbadie, in the Pyrenees, which yields an annual revenue of 20,000 francs, and bank shares yielding 15,000 francs. He was one of the earlier explorers of Abyssinia, observed the eclipse of the sun of 1882 in Santo Domingo, and published important works on geographical exploration and geodesy.

Prof. Charles Tomlinson, who died February 14th, in his eighty-ninth year, was on the Council of the British Association for the Advancement of Science, a fellow of the Royal Society, a fellow of the Chemical Society, and one of the founders of the Physical Society. For a number of years he was lecturer on Experimental Science at King's College, and was examiner in physics to the Birkbeck Institution. He held the Dante lectureship at University College, 1878–'80. He wrote many handy text-books on natural philosophy, meteorology, and natural history, and contributed largely to the Transactions of the Royal and Chemical Societies. In 1854 he edited Tomlinson's Cyclopædia of Useful Arts, Mechanical and Chemical, Manufactures, Mining, and Engineering. He compiled the lives of Smeeton, Cuvier, and Linnæus, and the notices of scientific men in The English Cyclopædia of Biography.

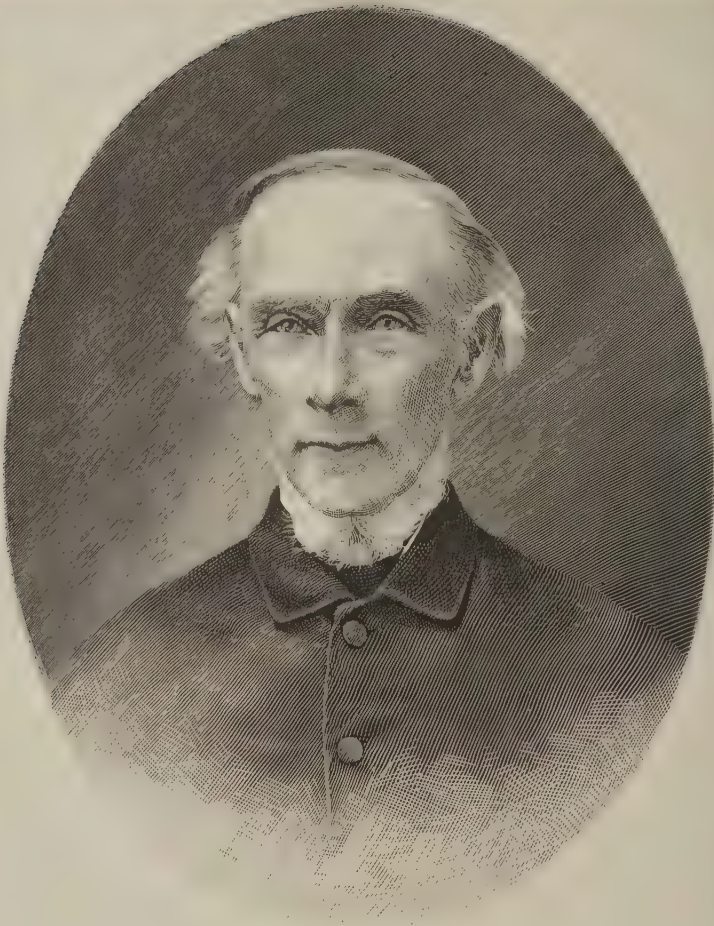
Among the men of science abroad who have died are Dr. Nikolai Zdekaner, St. Petersburg, member of the Imperial Academy of Sciences, and known for his work in behalf of hygiene and knowledge of epidemics; Herr Alois Rogenhofer, formerly Curator of the Imperial Natural History Museum in Vienna; Dr. Hermann von Noerdlinger, formerly Professor of Forestry in Tübingen University; Dr. Luigi Calori, Professor of Anatomy in the University of Bologna; Dr. J. D. E. Weyer, Professor of Mathematics and Astronomy in the University of Kiel; and M. Vivien de St. Martin, famous for his researches in ancient geography.

The death is announced of Mr. Henry Boswell, a noted bryologist. Beginning his botanical studies with flowering plants, he later on turned his attention to the study of mosses, both British and foreign, and made a fine collection.

It seems certain that eels, while not exactly amphibious, venture to spend considerable intervals of time on the land, away from water. A German zoölogist, Herr Frenzel, as well as several other persons, recently observed a young eel, about five inches long, concealed in the network of the superficial roots of a bush. It had come from a pond about fourteen feet away, and six feet lower down, and must have exerted vigorous efforts to climb the bank.

A consignment of the American crawfish (*Cambarus affinis*) has been received at the French agricultural station Fécamp, for acclimatation and propagation. These crustaceans are said to have been taken from the waters of the Potomac. They are sought because they appear not to be subject to the disease which has carried away most of the crawfish in the rivers of France, and are intended to make up for the loss occasioned thereby.

One of the latest papers of the late Sir Benjamin Ward Richardson set forth the qualities of organic membranes as insulators. Experiments were cited by the author going to show that various membranes of the animal body, in addition to performing the functions usually ascribed to them, are also electrical insulators, and by their presence confine and render useful the vital force that is developed in the organs they surround.



RICHARD OWEN.

APPLETONS'
POPULAR SCIENCE
MONTHLY.

JUNE, 1897.

EVOLUTION OF THE MODERN HEAVY GUN.

By W. LE CONTE STEVENS,
PROFESSOR OF PHYSICS IN RENSSELAER POLYTECHNIC INSTITUTE.

DURING the last half of the nineteenth century, a period of extraordinary fertility in the industrial application of all departments of physical science, it would be remarkable if great progress were not made in the development of the materials of warfare, both offensive and defensive. It is true there have been few great wars during the half century just closing, fewer than during the corresponding previous period, when Napoleon made all Europe his chronic battle ground. But with progress in the arts of peace there comes progress in machinery of all kinds. Guns are machines which happily we are not often called upon to use in deadly earnest. The degree of perfection with which a machine does deadly work serves as a powerful argument to induce caution before bringing it into use. If the civilized world ever attains the millennium of freedom from warfare, it will not be because the philosophy of good will to men has triumphed, but because war is too terrible and costly for any nation to risk the sure and swift destruction it brings upon the vanquished. Patriotism will not be extinguished, but it will be tempered with the spirit of rational compromise. During the thirteen years of Napoleon's leadership his wars cost France one billion dollars. During the four years of civil war in America the cost to the Government of the United States was about four billion dollars, apart from treasures expended in vain by the Confederate States. The American civil war was thus at least a dozen times more expensive per year than war was during the time of Napoleon.

With the construction and use of the materials employed in modern warfare none but the professional military engineer can be reasonably expected to attain much familiarity. But all have an interest in national preparation for contingencies, and even to the nonprofessional it may be an engaging study to trace in outline the evolution of the cannon as now made at great armories like that at Watervliet, near Troy, New York.

It would be only repeating an oft-told tale to show that our remote human ancestors were all savages, and that the normal condition of society among them was that of warfare. What were the earliest weapons employed we can only conjecture. If we disregard the long and for the most part unknown period that preceded the beginning of definite human records, we find that when these records began man was already acquainted with the ruder processes of metallurgy. But there are no indications that during the age of universal savagery metal was used to any great extent for projectile purposes. Arrows and javelins were early and abundantly employed, and the use of the sling was undoubtedly common among the Israelites long before the dramatic duel between David and Goliath. The Romans in conducting their sieges employed the catapult and ballista for the projection of large arrows and stones; but from the vague description of these instruments we can glean little more than that they were probably immense crossbows. They were unwieldy, but powerful enough to project stones, each as heavy as an ordinary man, over a distance of a hundred yards. During the first dozen centuries of the Christian era there was but little improvement over Roman methods of warfare.

That the elastic force of hot gas suddenly evolved should be substituted for that of a stout cord under great tension could not have been possible without the previous discovery of the means by which such gas could be appropriately generated. There is no probability that we will ever learn definitely the true history of the invention of gunpowder. Quite probably it was independently invented by different persons at different times. There can be little doubt that the knowledge of its composition existed at a very early date among some of the inhabitants of India, where the rich soil under a tropical sun has during many centuries been leached for the purpose of procuring niter. Assuming the presence of this salt in abundance, it would hardly be possible for one who handles it to remain long ignorant of its capacity to explode when sufficiently heated in contact with charcoal, sulphur, or any other kind of fuel. It is not surprising that some of the earlier alchemists should be credited with the preparation of gunpowder. It has been common to attribute its invention to Roger Bacon, whose life lasted through the greater part of the thirteenth century. But his language is characteristically vague; for, in regard to the mixing of saltpeter with sulphur and another undefined substance, he merely says, "You will thus make thunder and lightning if you know the method of mixing them."

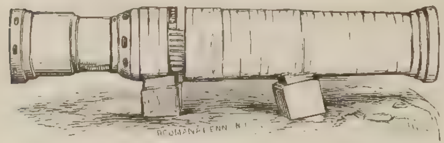
Another claimant to the invention of gunpowder was the German monk, Berthold Schwartz, who is said to have ground together in a mortar a mixture of niter, charcoal, and sulphur. Accidentally allowing fire to come into contact with the mixture, an explosion ensued. The pestle was projected from the mortar and from the hand of the surprised alchemist. This suggested the use of the uncanny substance for military purposes, and the mortar was subsequently made on a larger scale for the special purpose of propelling projectiles.

ROGER BACON. Born near Ilchester, about 1214; died probably at Oxford in 1292.

The determination of the proper percentages of niter, carbon, and sulphur in gunpowder implies a knowledge of the quantitative laws of chemistry. It is not to be supposed, therefore, that the earlier users of this explosive were able to make powder equal in quality to that of modern times, or that they knew how to adjust its granulation to the special purposes intended under varying circumstances. The Saracens seem to have introduced it into Spain for pyrotechnic purposes about the same time that Schwartz made his suggestion regarding its most important practical application. Its first definitely known use was for cannon. These were called "bombards," on account of the noise occasioned by firing.

The primitive cannon was a rude tube made up of iron bars hooped together, edge to edge, like the staves of a cask. It was by no means readily portable, and was not provided with any wheeled carriage. As an offensive weapon its natural place was on shipboard; as a defensive weapon, upon the wall of a besieged town. This iron barrel was firmly fastened down upon a horizontal bed or to a fixed framework of timber. The balls shot from it were of stone. Since there was no provision for aiming, it can be readily conceived that the enemy might be equally safe or unsafe at a variety of points in front of such an ostensible engine of destruction.

Small cannon, intended for transportation on land, were undoubtedly constructed early in the fourteenth century. They were used by the English, possibly as early as 1327, in battle with the Scotch, and certainly against the French in 1346, at the battle of Crécy. There is nothing to indicate that on this occasion any one was killed or wounded by a cannon. The sole function was that of frightening the enemy. Nor have we any record of the method of supporting or transporting such field artillery. It was rather as heavy artillery that cannon found their chief earlier use, and they were soon made of such size as to be quite comparable in this respect with modern guns. One of these bombards, made in Belgium in 1382, weighs about sixteen tons, is more than eleven feet long, and its caliber is about two feet. It is still kept on exhibition in the city of Ghent. Another is the "Mons Meg," made in 1486 at Mons in Brittany. It was captured by the Scotch, and is now kept at Edinburgh.



"Mons Meg" Cannon at Edinburgh.
Caliber, twenty inches. Made in 1486 at Mons, Brittany. The arrangement of hoops around staves is shown at the part injured by its bursting in 1682.

A gun somewhat similar in construction to that in Ghent was dug up about forty years ago from the bed of a river in Bengal, and now stands on exhibition in the city of Moorshedabad. It was made of wrought iron, was more than twelve feet in length, and about seventeen inches in caliber. That the forging of iron on so large a scale was accomplished at such a time and in such a place indicates a marked degree of progress in metallurgy in the far East, and adds force to the thought that cannon may have been in use in Asia long before they were ever employed in Europe.

During the siege of Constantinople, in the fifteenth century, according to Gibbon, the Turks employed cannon with which stone balls, each six hundred pounds in weight, were projected, and the walls of the city were thus breached. Von Moltke mentions such a gun at the same place, twenty-eight inches in diameter at the muzzle, with which a ball more than fifteen hundred pounds in weight was projected by a charge of one hundred pounds of powder. For some of these ancient Turkish cannon the diameter of the stone shot was as much as a yard, while the length of the gun was only five yards.

It is not therefore so much in the size of heavy ordnance as in its efficiency that we of to-day are warranted in claiming much superiority over our ancestors. The plan of hooping iron staves together gradually gave place to that of molding guns, sometimes in cast iron, sometimes in bronze. Wrought iron also came extensively into use for the purpose of gun construction. The gun was made up of a succession of short forged tubes jointed together. Over each joint a ring was shrunk on while hot, for the sake of strengthening the whole. Many guns made in this way during the sixteenth century are still to be seen in European museums.

The use of breech-loading cannon is of considerable antiquity, despite the great difficulty that has been experienced in securing safety in their use. Among the earliest breech-loading devices was that of a short movable tube or chamber, closed at one end. This was loaded to its muzzle and then inserted into the breech of the large tube. It was propped behind with a heavy block of wood or iron, and firmly wedged into position before firing. It is readily seen that with such loose fittings much of the force of the powder was wasted. None of these guns were provided with any facilities for adjustment in aiming. The stone projectile was but poorly fitted to the size of the bore. Not only did much of the expanding gas escape without doing useful work, but the strength of the gun was never sufficient to warrant a charge of powder large enough to send the projectile more than a few hundred yards.

In course of time it became evident that greater efficiency was attainable by the use of smaller cannon and more accurate fitting. The clumsy and unmanageable heavy guns were discarded, and their places supplied by guns many of which were small enough to be carried by a single man. The introduction of the musket was merely one phase in the fluctuation of the waves of custom, a reaction after many unhappy experiences in the use of large cannon which had been inefficient and often more dangerous to the user than to the enemy. The musketeer with his burdensome flintlock became more important than the cannoneer in field work. A variety of forms of small cannon came into use, all of which were, like the muskets, smooth-bored, muzzle-loading arms, made of cast metal of one kind or another. Iron balls were substituted for those of stone, and about the beginning of the present century a weight of eighteen or twenty pounds was deemed best for most artillery purposes. War ships were equipped with armaments sometimes in excess of a hundred small cannon. Custom had fluctuated to the other extreme, but at this stage of evolution guns had become well differentiated into two classes, the musket and pistol being representatives of the one, while the portable cannon was a type of the other. Each was crude in comparison with the war machines of to-day, but efficient enough to make Napoleon the terror of Europe. This warrior's celebrated remark that "God is on the side of the heaviest artillery" was an indication of his view that the limit had not been reached, and that the art of cannon construction was enough developed to warrant the making of yet larger guns.

In the War of 1812 an American officer, Colonel Bomford, introduced a large cast-iron gun, intended specially for seacoast defense by firing bombshells at long range. Up to this time cannon had been made with little or no provision for the variation of stress in different parts of the gun due to the exploding powder. It was known that this stress must be greatest around the seat of the charge, but no experiments had been made to determine even roughly the rate of decrease, although methods were already in use for ascertaining the initial velocity of the projectile shot forth. Bomford bored a hole into the side of a cannon and screwed into this a pistol barrel, with a bullet inserted. A definite charge of powder being exploded in the cannon, the velocity of the pistol bullet gave a measure of the pressure at that point. A series of holes being made in succession from muzzle to breech, the corresponding velocities of the discharged bullets gave an indication of the relative strengths needed to resist explosion and the thickness of metal required. The form of gun was therefore modified to suit the stress, and greater strength in proportion to weight was thus secured. To this improved gun he gave the name of columbiad. This style of gun was soon adopted in Europe, and long continued to be a standard.

But there were inherent weaknesses due to the very fact of employing cast metal. Assume a mass of hot liquid iron poured into a mold to form a solid cylinder, the central part of which is to be afterward bored out. The exterior surface cools first and becomes a rigid solid, while the whole mass has contracted but little. Gradually the interior hardens and crystallizes, but normal contraction is prevented by the rigidity of the exterior shell. The condition of the mass is much like that of a Rupert's drop of glass, which breaks into fragments as soon as the outer shell is broken. The weakest part of the cylinder is the axial region, which is removed by being bored out; but still the weakest parts of the completed gun are its inner surface and breech, the very parts against which the greatest force of the exploding charge is exerted. With such a gun the limit of safety is exceedingly uncertain. The vibration due to discharge weakens the cast iron, and the gun becomes dangerously weak after but little use. Nevertheless, this method of construction did not begin to receive modification of any great importance until about fifty years ago. In 1846 these smooth-bore, cast-iron columbiads varied in caliber from eight inches to twenty inches, and in weight from four tons to fifty-seven tons. The projectiles were spherical iron balls, from sixty-eight to one thousand pounds in weight, the charge of powder never exceeding one sixth of the weight of the ball.

The Tsar Cannon at Moscow.
Caliber, thirty inches. Seventeenth century.

Between 1850 and 1860 Major Rodman, of the United States Army, conducted an epoch-making series of experiments on the improvement of gunpowder and the method of casting iron guns. Dahlgren, about the same time, modified the form of gun, giving it great thickness at the breach and as far as the trunnions, with rapidly diminishing diameter thence to the muzzle. This form has often been compared to that of a champagne bottle. The contrast between this and the older forms is well shown by comparing the "Tsar cannon," a thirty-inch gun of the seventeenth century, now in the arsenal at Moscow, with the United States fifteen-inch columbiad, as improved by Dahlgren. Accepting the proportions thus established, Rodman devised the method of "hollow casting" and cooling from the interior. The melted iron is poured into a vertical mold, the axis of which is occupied by a hollow core. Through a pipe in this cold water is conveyed to the bottom and conducted away at the top after being warmed by the surrounding hot metal. The hardening of this begins thus at the inner surface where the greater strength is needed. The exterior surface of the mold is at first strongly heated from without and this heat gradually diminished, while the flow of water is continued many hours or even days. The cast iron thus goes through a process much like the tempering and annealing of steel. As the metal gradually cools the inner surface becomes strongly compressed, and the outer surface is left in a state of tension. The condition is the exact reverse of that brought about by the older process of solid casting and subsequent boring. The great improvement in strength secured by this process is indicated by Rodman's testing of two columbiads of the same size, material, and form, made at the same time, the one by hollow casting, the other by solid casting. The solid-cast gun burst at the eighty-fifth round, the hollow-cast at the two hundred and fifty-first round. Its endurance was thus three times that of the other.

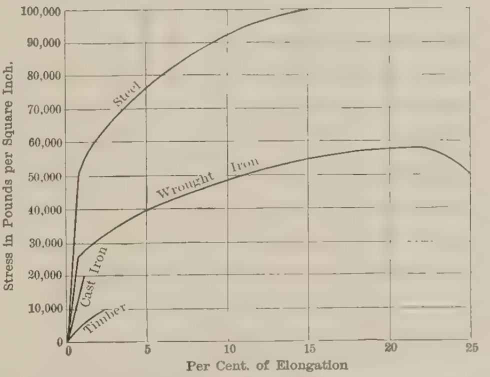
Rodman's process was of fundamental importance, because it established experimentally the principle of initial exterior extension and interior compression. This principle is applied in all gun construction to-day, although the use of cast iron has been wholly discarded. Like many other ideas of great importance in the history of invention, it seems to have been evolved independently by several claimants. The names of Blakely, Whitworth, Armstrong, Longridge, Brooke, Treadwell, and Parrott are at once called to mind. To describe their inventions and discuss conflicting claims would require a volume. The discovery of such an important principle, followed by the outbreak of the American civil war, gave an impetus to the improvement of ordnance which was felt over the entire world.

Rodman Fifteen-inch Gun.

Hitherto the materials used in gun construction were cast iron, wrought iron, and bronze, this last being an alloy of copper with ten per cent of tin. In tenacity bronze is superior to cast iron, but it is softer, more fusible, and more expensive. Cast iron is moderately fusible, but not fixed in composition, having a variable amount of carbon, silica, and other impurities diffused through its mass. Its properties are correspondingly variable, but it is in general hard, brittle, and more or less crystalline. Wrought iron is the result of oxidizing out all of the carbon by puddling, then squeezing out the silica, and rolling so as to develop a fibrous in place of crystalline structure. It is much more tenacious than cast iron, almost infusible, but capable of ready welding and forging. The admixture of carbon seems to confer the property of fusibility.

Steel is the product of the recombination of pure wrought iron with a very small percentage of carbon and sometimes of manganese or nickel. Like cast iron, it is fusible; like wrought iron, it can be readily forged; and it is superior to each in elasticity and tenacity. The idea long ago suggested itself that steel ought to be the best material for the construction of cannon. But the practical obstacle was the great difficulty of securing large enough forgings of steel, and this of sufficiently good quality. Only since 1860 have the methods of steel manufacture been so improved as to make this metal available on a large scale.

So important is the relation between cast iron, wrought iron, and steel that it may be well to illustrate this by the use of a diagram due to Professor Merriman. Assume that short rods of these materials, each of the same length and one square inch in cross-section, are subjected to great stretching force by the use of a testing machine. As this force increases up to the elastic limit of six thousand pounds, the cast-iron rod becomes elongated proportionally. It breaks suddenly when the stress reaches twenty thousand pounds. At this limit of tenacity the rod has been increased in length less than one per cent, as shown in the diagram. The wrought iron becomes lengthened at a less rapid rate, reaching its elastic limit for a stress of about twenty-five thousand pounds. In each case, up to the elastic limit, if the stretching force be removed the rod will recover its former length and condition. On further increasing the stress, the wrought iron stretches at a more rapid rate, and bears a stress as great as fifty-eight thousand pounds. If now the force be withdrawn the iron remains in its deformed condition, the lengthening being about twenty-two per cent. On again applying the stress there is further rapid lengthening up to twenty-five per cent, this yielding causing a decrease of stress till the rod breaks at a limit below fifty-eight thousand pounds. The elastic limit and the breaking limit are thus widely different. In the case of steel the elastic limit is not reached until the stress becomes fifty thousand pounds. Its elastic limit is thus double that of wrought iron. Further increase of stress now causes the steel to increase its rate of stretching, and permanent strain results. Its breaking limit, one hundred thousand pounds, is nearly double that of the wrought iron, and is reached when the yielding attains fifteen per cent. This is not much more than half of the twenty-five per cent of yielding of the wrought iron.



CURVES SHOWING TENSILE STRENGTH OF TIMBER, CAST IRON, WROUGHT IRON, AND STEEL.

The figures just given are only averages. Cast iron has been made with a tenacity in excess of forty thousand pounds, while that of steel may vary in different specimens from sixty thousand to three hundred thousand pounds. This wide range shows that for the construction of a heavy gun, if steel be employed, the utmost care should be exercised to secure that of the highest grade possible, in order to withstand the enormous tension due to explosion. As soon as this tension becomes equal to the limiting measure of elasticity for the steel, the wall must yield, even if the thickness of the gun were infinite. Since the breaking limit, or ultimate tenacity, of cast steel has just been seen to be, on an average, at least five times that of cast iron, it follows that, with the same diameter and thickness of metal and the same weight of projectile, a steel gun warrants the use of a charge of powder of the same quality five times as great.

Professor Treadwell showed in 1856 that, if we assume a gun to be made up of a large number of uniform, cylindrical, concentric layers of metal, then the resistance of each layer to the bursting force of explosion will vary inversely as the square of the diameter. The stress, therefore, decreases at a rate very similar to that of the radiation of heat or light. If the wall of the gun be under no initial stress of any kind, its inner portion must have great resisting power, and very little is gained by thickness of wall much in excess of the diameter of the bore. Treadwell therefore proposed a plan of construction by which a cast-iron tube of only moderate thickness should be re-enforced by a series of layers of encircling wrought-iron hoops. These should be shrunk on while hot, so that, after cooling, the cast iron tube is strongly compressed while the wrought-iron hoop becomes stretched. The force of compression is thus added to the ordinary strength of the cast iron to resist explosion. With various modifications this plan has been carried out by most gun constructors during the last forty years. During the civil war it was applied with great success by R. P. Parrott, of West Point, and by Blakely, Armstrong, and Whitworth in England.

It is perhaps impossible to say what inventor was the first to introduce the use of rifled cannon. They have now entirely superseded smooth-bore guns. The Parrott rifled cannon, made of cast iron according to the Rodman plan and re-enforced around the chamber with a hoop of wrought iron, was the most generally serviceable gun employed during the late war, more than two thousand of them coming thus into use. The largest of these was twelve feet in length, with a bore ten inches in diameter, its weight being about twelve tons. A charge of twenty-five pounds of powder was employed to project a shot weighing two hundred and fifty pounds. The cost of its construction in 1863 was forty-five hundred dollars.

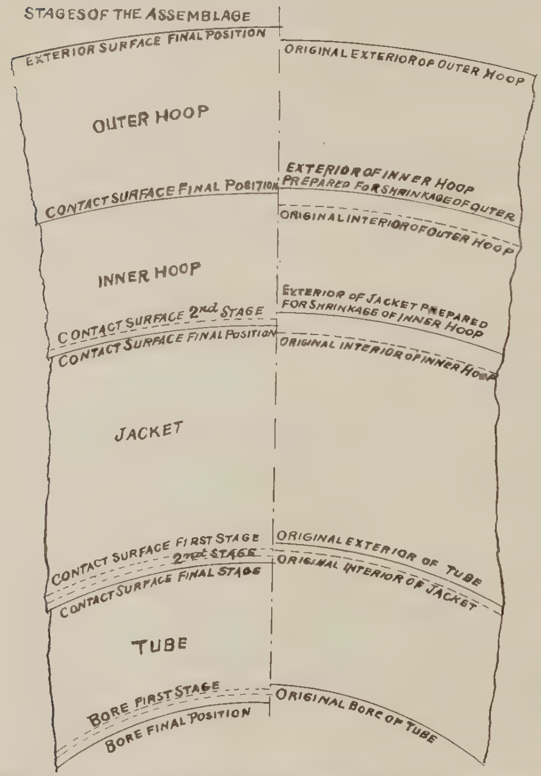
These details are given for the sake of subsequent comparison with the rifled cannon of to-day. For twenty years after the close of the war there was a period of stagnation in America, so far as development in ordnance was concerned. Our coast defenses continued to be provided with nothing better than the Parrott rifles and smooth-bore Rodman guns which had been in use during the war. Meanwhile there had been great progress in Europe, particularly in France and Germany. In 1885 a commission appointed by Congress reported the necessity for heavy expenditure of money in order that this country be put into a condition of reasonable readiness to repel foreign invasion. During the last ten years appropriations to the amount of twenty million dollars have been made to meet these needs, and the work of rehabilitation is now well started.

The rifled gun of to-day, as finished at the Watervliet Arsenal, is constructed almost wholly of steel. This is of the best quality that can be produced on a large scale in American foundries. It is made by the "open-hearth" process, for the most part at Midvale and Bethlehem in Pennsylvania. The forgings, after undergoing thorough official inspection and careful testing, are sent to the great gun shops at Watervliet. Here the various parts composing a gun are worked up, assembled together, and finished. Before assignment for government service each gun is subjected to a searching test, more severe than should reasonably be expected in actual use.

The largest gun thus far designed at Watervliet is a rifle of twelve-inch bore, forty feet in length, and fifty-seven tons in weight. From such a gun an elongated steel-pointed projectile, weighing one thousand pounds, or as much as an ordinary horse, is shot with a charge of five hundred and twenty pounds of powder. It receives an initial velocity of two thousand feet per second, and would penetrate through rather more than two feet of steel armor plate put in front of the muzzle. If shot into the air at the proper elevation it would pass over a range of nearly nine miles. Such a missile, thus fired from the lower end of New York city, would pass over Central Park into the district beyond Harlem River. This range would be covered so quickly that the shot would reach its destination several seconds before the sound of the explosion is heard at the same point. The initial energy of the projectile would be sufficient to lift a weight of twenty-seven thousand tons through a height of one foot. If this weight were that of a spherical mass of gold, the heaviest popularly known metal, its diameter would be nearly forty-six feet, and its value eighteen billion dollars. This is more than a dozen times the value of the total gold production of the world during the last twenty years.

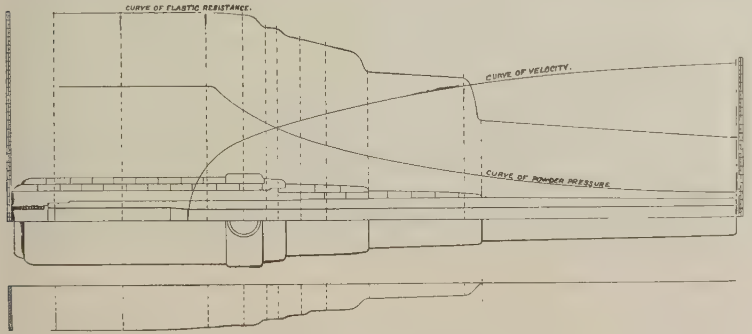
The cost of such a gun is about sixty thousand dollars; that of the charge of powder, one hundred and seventy-five dollars; of the armor-piercing projectile, three hundred and fifty dollars.

The cost of a single discharge thus exceeds five hundred dollars. But this is not all. So great is the wear and tear of each discharge upon the bore that after two hundred and fifty rounds the gun becomes unfit for further use until it is relined by the insertion of a new rifled tube within the original tube, the old rifling having been removed. The gun will then stand two hundred and fifty more rounds. Assuming six hundred rounds for the entire life of the gun, each round thus costs one hundred dollars in wear and tear, in addition to the five hundred dollars' worth of material used in loading. Such a gun as this is but a single small element in the cost of a modern war. Several of them, besides a number of smaller guns, are usually placed on every large armor-clad battle ship. The cost of this with its equipment mounts up into millions of dollars. Nevertheless, it has been necessary to coin into our language the word "jingo," to designate the bragging noncombatant who clamors for war because of the fancied stimulus which it is supposed to give to patriotism and prosperity. On comparing this gun with the largest Parrott rifle of thirty years ago we see that its length is more than three times, its weight nearly five times, and its cost thirteen times as great. For the cast-iron Parrott gun the charge of powder weighed about one tenth as much as the projectile. For the modern steel gun this ratio is raised to one half, with corresponding increase of destructive energy.


STAGES OF THE ASSEMBLAGE
EXTERIOR SURFACE FINAL POSITION
ORIGINAL EXTERIOR OF OUTER HOOP
OUTER HOOP
EXTERIOR OF INNER HOOP PREPARED FOR SHRINKAGE OF OUTER
CONTACT SURFACE FINAL POSITION
ORIGINAL INTERIOR OF OUTER HOOP
INNER HOOP
EXTERIOR OF JACKET PREPARED FOR SHRINKAGE OF INNER HOOP
CONTACT SURFACE 2nd STAGE
CONTACT SURFACE FINAL POSITION
ORIGINAL INTERIOR OF INNER HOOP
JACKET
CONTACT SURFACE FIRST STAGE
2nd STAGE
CONTACT SURFACE FINAL STAGE
ORIGINAL EXTERIOR OF TUBE
ORIGINAL INTERIOR OF JACKET
TUBE
BORE FIRST STAGE
BORE FINAL POSITION
ORIGINAL BORE OF TUBE

SECTIONAL DIAGRAM, showing compression of tube and extension of hoops after assemblage of the component parts of a gun.

Passing now to the construction of the modern gun, a longitudinal section shows an inner tube rifled within and slightly enlarged at the breech end of the bore. Around this is a long tubular jacket extending from the breech two thirds of the length of the gun. Around this jacket is a series of compressing hoops, and around this a second or outer series of the same. Originally the interior diameter of the jacket is a little less than the exterior diameter of the tube. By heating the jacket sufficiently it is made to expand until it can be slipped over the cold tube, which becomes enormously compressed by the subsequent cooling of the jacket. In like manner the first hoop is too small to be slipped over the cold jacket except when heated for this purpose. The same remark applies to the second hoop. The final result, as shown by the cross-sectional diagram on opposite page, is that the diameters of the tube, both internal and external, are permanently diminished by the compression of the jacket, while those of the hoops are permanently increased. Their contractile force is not sufficient to compress the jacket, which is itself resisting the enormous reacting force of the compressed tube within. The hoops therefore serve to re-enforce the jacket by their own tendency to contract from the enlarged condition in which they were applied while hot. They are in a state of permanent tension. The scale of differences exhibited in the diagram is greatly exaggerated to make these perceptible. The longitudinal diagram shows by curves how the expansive force of the exploding powder diminishes from breech to muzzle, how the yet greater elastic resistance of the steel components, after they are assembled together, is adjusted to resist this expansive force, and how the velocity of the projectile increases from breech to muzzle.



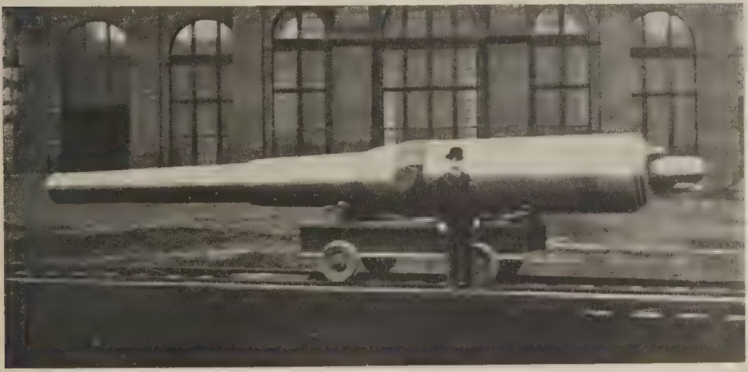
Curves showing Decrease of Elastic Resistance, Powder Pressure, and Increase of Projectile Velocity.

All rifled guns built in America at present, whether for seacoast, siege, or field artillery, are breech-loading. Many futile experiments were made before a successful breech-loading mechanism was perfected. An explanation of either of the two modern systems would be beyond the scope of the present discussion. It may be sufficient to say that the system in use in America is substantially that of the French, an interrupted screw which fits into the breech and is provided with an efficient gas check. This is so constructed that the mere fact of explosion tightens the gas check and effectually prevents the escape of hot gas between the threads of the screw.

TWELVE-INCH RIFLE, WITH BREECH-LOADING MECHANISM CLOSED.

The largest and most celebrated gun factory in the world is that of Krupp, at Essen in Germany, near the Belgian border. Besides monopolizing the construction of guns for the German Government, this factory has supplied a great number to most of the leading powers of Europe. It was established in 1818, and from the very outset attention was concentrated upon the making of steel. The first finished piece of artillery in cast steel was made in 1847. This was a small field gun capable of projecting a ball of only three pounds. The manufacture of steel at these works has since been so perfected that Krupp can now be scarcely said to have an acknowledged rival in the world. His magnificent display at the Chicago Exposition was seen and admired by many thousands of visitors. Among these exhibits was a steel rifle forty-two centimetres (16·54 inches) in caliber, and thirty-three calibers (forty-six feet) in length. Its weight is one hundred and twenty tons, or a little more than double that of the twelve-inch rifle at Watervliet. With a charge of nine hundred pounds of powder it gives an initial velocity of two thousand feet per second to a projectile weighing twenty-two hundred pounds, whose initial energy is thus sixty thousand foot tons. When fired at an elevation of about eleven degrees it sends this projectile to a distance of five and a half miles, and it pierces through armor a yard thick at a distance of a mile and a quarter. Another rifle, twenty-eight centimetres (eleven inches) in caliber and forty calibers (thirty-seven feet) in length, when elevated forty degrees sends a seven hundred and sixty pound projectile over twelve and a half miles. This is the distance from the Battery to Fordham in New York city. The shot reaches an extreme height of a trifle over four miles. It could thus be easily made to clear the highest mountain peak in North America.

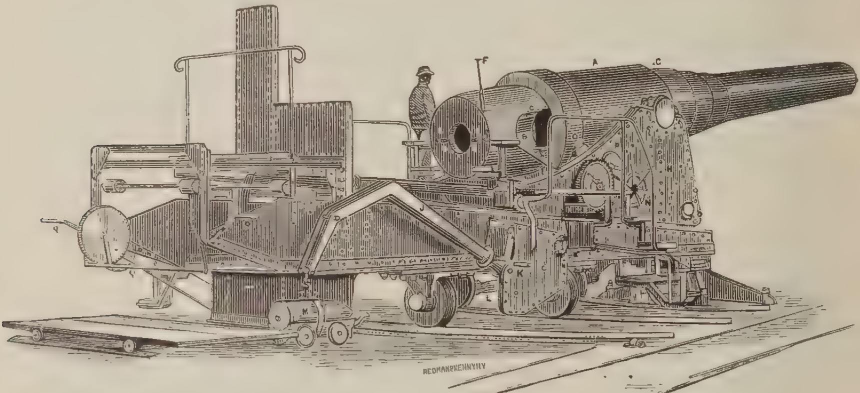
The power of endurance of a gun diminishes rapidly with increase of projectile power. The life of the American twelve-inch rifle has been given as only five hundred or six hundred rounds, while a field gun of modern make may be fired thousands of times if used with reasonable care. Within the next two years a new rifle of sixteen-inch caliber will be constructed at Watervliet. This is nearly equal in size to the monster Krupp gun at Chicago. Such immense guns can be employed only for seacoast defense. In handling them complex machinery is necessary, not only for moving and adjusting the gun but for loading it. No group of soldiers could without machinery lift and put into place a projectile weighing a ton. It seems doubtful whether any real advantage can be gained by going beyond the limits of size already reached. The difficulty at present is not confined to that of manipulation, but extends to the quality of the forgings made on so large a scale. Krupp makes his guns entirely of "crucible" steel, such as is employed for cutlery. Made by this method, steel is indeed the most uniform in composition, but nowhere outside of the Krupp works has it been manufactured on a scale large enough for great gun forgings. In France, in England, and in America, the "open-hearth" process is depended



Twelve-inch Rifle, with Breech-loading Mechanism Open.

upon, which yields a high grade of steel; but in uniformity of composition and elasticity it can scarcely be equal to the more expensive crucible steel. This perhaps may at present be only a matter of opinion. On such a point no definite and final conclusion should be reached without a series of comparisons such as can not be accomplished in a day.

An unfortunate mishap which occurred at Watervliet in 1895 may have some bearing in this connection. In assembling the parts of a forty-caliber twelve-inch rifle, the tube was, as usual, rested vertically upon its breech end, and the heated jacket was let down over it. The heating had been insufficient to secure all the expansion needed, and as a result the cooling jacket gripped the tube before quite reaching the final position intended. An interesting problem was now presented, that of separating the tube and jacket after they had become thoroughly cool, and completing the process which had been so unexpectedly interrupted. The gun was provided with the inlet and outlet tubes such as Rodman employed to secure a continuous flow of water in hollow casting, and the exposed part of the tube below the edge of the jacket was inclosed in a bag of asbestos cloth through which a stream of cold air could be transmitted. The gun with its adherent jacket and these adjuncts was let down into a furnace so as to heat the jacket. Immediately a flow of cold water was started through the tubes, and of cold air through the bag, while the inclosing jacket was soon raised to a temperature estimated to be 1100° F., which was maintained for several hours. The experiment proved unsuccessful. It was subsequently repeated twice with slight modifications, but all in vain. To test the correctness of the theory thus applied, a "dummy" was constructed, its parts



Krupp Sixteen-inch Gun, mounted on Coast Carriage.
Weight of gun, seventy-one tons.

assembled together firmly, and the experiment of separating them was rewarded with prompt success. On account of the magnitude of the large gun it had been impossible to heat it with perfect uniformity from without, while no such difficulty was experienced with the much smaller dummy. A series of measurements upon the large gun revealed the fact that during the first experiment it had become warped, and the diameter of the tube had been diminished in varying degrees at different parts.

Whether such results as these would have been brought about had the materials been of the best quality of crucible steel instead of open-hearth steel can not be answered positively. The larger the gun the greater is the danger of such mishaps. It is left to coming experience to determine which is to be the steel of the future for gun construction.

THE SILENT CITY OF THE MUIR GLACIER.

By DAVID STARR JORDAN,
PRESIDENT OF LELAND STANFORD JUNIOR UNIVERSITY.

MR. RICHARD G. WILLOUGHBY is a mining prospector and "promoter," resident in Juneau, Alaska, a man whose vocation enables him to see some wonderful things. In June, 1888, according to his statement, Mr. Willoughby beheld an extraordinary mirage from the surface of the Muir Glacier. It was the apparition of a great city of tall houses of brick and stone, plainly shown in the air under the influence of some powerful refraction. Behind the city was a river in which shipping was faintly shown. In the foreground the leafless branches of tall elm trees were clearly traceable. In the center of the city was a large edifice with several towers, and on some of these towers the presence of scaffolding showed that building was still going on. This mirage was seen by him several times from year to year, and on the unfinished building the stages in the process of erection each season could be distinctly followed.

Mr. Willoughby sent to San Francisco and secured a camera with a number of highly sensitized plates of the usual commercial sort in order to photograph the apparition. This he succeeded in doing but once successfully. The necessary exposure was a very long one, because of the unsubstantiality of the object. The one negative, however, gave a fairly clear print. Copies were at once made, and R. G. Willoughby's Silent City (seventy-five cents each) was added to the wonders of Alaska. I present herewith a copy of this picture bought by me in Sitka in 1896. The picture is not quite the same as the original edition of 1888.

The scene is exactly identical, but the card has been reduced in size by the omission of superfluous sky. It has been rendered much fainter and more ghostlike than the original, and is perhaps taken from a new negative in which the lines of the houses and gravel walks have been purposely made less distinct.

The original edition has the following on the back of the card:

"THE GLACIAL WONDER OF THE SILENT CITY.

"For the past fifteen years Prof. Richard Willoughby has been a character in Alaska as well known among the whites as he has been familiar to the natives. As one of the early settlers of old Fort Wrangel, in which his individuality was stamped among the sturdy miners who frequented the then important trading port of Alaska, he has grown with the Territory and is to-day as much a part of its history as the totem poles are identified with the deeds of valor or commemorative of the past triumphs of prominent members of the tribes which their hideous and mysterious characters represent.

"To him belongs the honor of being the first American who discovered gold within Alaska's icy-bound peaks, but his greatest achievement from a scientific standpoint is his tearing from the glacier's chilly bosom the 'mirages' of cities from distant climes.

"After four years of labor amid dangers, privations, and sufferings, he accomplished for the civilized world a feat in photography heretofore considered problematic.

"It was on the longest day of June, 1888, that the camera took within its grasp the reproduction of a city remote, if indeed not altogether within the recesses of another world. The

SILENT CITY

is here presented for the consideration of the public as the wonder and pride of Alaska's bleak hills, and the ever-changing glaciers may never again afford a like opportunity for the accomplishment of this sublime phenomenon."

The picture attracted much attention and met with an encouraging sale. The skeptical bought it as an original document in the natural history of mendacity. The credulous regarded it as a wonder not surpassed by the gigantic glacier itself. The discussion arose in the newspapers as to whether some distant city, as Montreal, could have been brought into view by the freaks of the marvelous Alaskan atmosphere. Many who thought this impossible leaned to the belief that in the heart of Alaska or in British Columbia there is some great settlement of civilized men, as yet undiscovered by geographers. To those who held this opinion neither the nearness of the houses to the observer nor the

R. G. Willoughby's Mirage [the Silent City,] Alaska.

peculiarities of the vegetation (leafless elm trees in midsummer) nor the tiles on the chimneys offered any difficulties. The obvious but commonplace explanation was that of the few only. Even now, every summer, some account of the marvel goes the rounds of the newspapers. I am told that in 1896 a company of people encamped for some time on the glacier, in hopes of seeing this great wonder of Nature.

They did not see it, unfortunately, but others had better success, and these lucky ones have recently substantiated their account by their affidavits. An affidavit in Juneau costs but a drink of whisky, the usual price along the Northwest coast, a fact of which one great nation of our day has not been slow to profit in connection with an International Tribunal of Arbitration. As the sale of photographs declines, more persons will probably be granted a sight of the Silent City, and there will arise a new series of affidavits and newspaper stories.

It is hardly necessary to call the attention of the intelligent reader to the absurdities involved in Mr. Willoughby's story and in the photograph which is its financial justificaion. But there are many persons, not without education and culture, who believe without the least question any tale which is uncanny or which seems outside the ordinary run of things. In vain does Science protest that the natural order is the only order there is, that all contradictions to it are either so in appearance only or else are deceptions or frauds.

An interest in human psychology led Dr. Charles H. Gilbert, then acting as naturalist on the Albatross, to investigate Mr. Willoughby's methods of photography. He learned from Mr. Willoughby that the plates used were of the ordinary sort, but that the mirage required a very long exposure to set the picture. Mr. Willoughby had had no previous knowledge of photography, and had never tried to reproduce anything except mirages. The chemicals used in developing the negative he would not describe. It was a secret process. The exposed plates had to be soaked for three months in the secret compound before the picture would be fixed. This soaking took place in the open daylight, no dark room being required, nor did Mr. Willoughby seem aware of the ordinary function of the dark chamber in photography.

The original negative, examined by Dr. Gilbert, was a very old, stained, and faded plate, apparently a negative which had been discarded because underexposed.

Prof. William H. Hudson, of Stanford University, who lived for a time in Bristol, England, recognizes the picture as a view of that city from Brandon Hill, above the town. The picture must have been taken some twenty years ago, because Prof. Hudson distinctly remembers the scaffolding around the towers of Bristol Cathedral at that time while the building was being repaired. The hotel and the church to the left of the cathedral are also recognized by him.

A more transparent fraud could hardly be devised, but its very imbecility assures its success. We may be certain that for many years to come the "Silent City" will be the "wonder and pride of Alaska's bleak hills," and tourists eager to "pierce the veil" will speculate on the probability of its being "perhaps altogether within the recesses of another world."

Thus it comes about, as I have elsewhere said, that "there is no intellectual craze so absurd as not to have a following among educated men and women. There is no scheme for the renovation of the social order so silly that educated men will not invest their money in it. There is no medical fraud so shameless that educated men will not give it their certificate. There is no nonsense so unscientific that men called educated will not accept it as science."

PRINCIPLES OF TAXATION.

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VIII.—NOMENCLATURE AND FORMS OF TAXATION.

THE most simple form of taxation is a *poll* or *capitation* tax. Both terms may be regarded as identical in use and meaning, but the former is probably more frequently used in tax treatises and discussions.

WHAT IS A POLL TAX?—In a strictly economic sense the essential requisite of a "poll" or "head" tax is that it be laid on all polls or heads, and be unvarying in amount. A varying poll tax would be an arbitrary exaction, and would not be sustained for a moment as a proper exercise of the right of taxation, if laid without reference to a man's ownership of property. So soon, however, as the amount of the tax exacted is made dependent upon the amount of the property owned, the tax ceases to be a varying poll tax, and becomes a tax on the property itself. The popular idea of a poll tax in the United States is an annual tax, small in amount, uniform as respects rate, and applicable only to adult male persons. Such conceptions are not, however, in accord with historical experience, which is to the effect that uniformity in assessment has never been an essential or even usual feature of this form of taxation, but as a rule the tax has been intentionally rated to the person assessed according to his rank and station and supposed property. The "poll" or "capitation" tax of history has, therefore, been rather an "income" than a *per capita* tax; and the poll tax of the United States finds few precedents in history. Under the Byzantine Empire a so-called universal poll tax was substituted in lieu of almost all the tithes, customs, and excises which had before been relied on for revenue; and this substitution and its influence was regarded by Hume as one of the chief causes of the decadence of the Roman state (see page 584, vol. xlviii, March, 1896).

The first so-called poll tax in England was granted in 1377, and from that date down to the time of Queen Anne was an important source of revenue, and, not being uniform, except in its incidence *per capita*, gave rise to great popular dissatisfaction, both by reason of its amount and inequality, and also by the inquisitorial methods employed for its assessment and collection. At first (1377) the rate was fourpence on every head, male and female, above fourteen years of age. Subsequently, under the reign of Richard II, in order to avoid the unfairness of subjecting all—rich and poor, noble and serf—to such a uniform tax, a more equitable system was introduced, the taxpayers being classified by reference to rank, condition of life, and property, the rate ranging from six pounds thirteen shillings for dukes and archbishops, to two pounds for barons and knights, and three shillings fourpence on those of "least estate." The retention of the former uniform rate of fourpence on all married laborers and upon all single men and women above fourteen years of age, who were presumed to be without estate, was, however, a cause of great dissatisfaction among the masses, and the attempt to collect it undoubtedly constituted the prime cause of the famous "Wat Tyler rebellion" of 1381. In the case of the last poll tax authorized in England under Queen Anne a like attempt at classifying persons was continued; the rate commencing at one shilling per annum on all persons worth more than fifty pounds, and rising to ten pounds for peers of the realm, both spiritual and temporal. One curious provision of this final enactment was, that in all cases Catholics were to pay double the rate imposed on Protestants. Bachelors and widowers without children were also subjected to special rates. Some writer has remarked that such exactions could only have been designed and authorized by a government of misanthropes; for if one with a view of escaping them abandoned single blessedness, he only involved himself in greater difficulties; for there was a tax upon marriages, a tax upon births, and, if the health of the victim broke down under these exactions, a sum varying from three to thirty florins, according to his station, had to be paid before his sorrowing relatives could bury him. These taxes on marriages were enforced in England from 1695 to 1705, and during the first five years of their continuance yielded an average annual revenue of about two hundred and fifty thousand dollars. It was noted that their continuance had the undesirable effect of increasing the number of marriages by irresponsible persons, and in a manner devoid of all solemnity. The rates imposed in England as late as 1706 on bachelors and widowers contracting marriage varied according to the class in life to which they belonged; from thirty pounds to twenty-five pounds on the elder sons of the higher orders of nobility to twelve shillings on persons possessed of an income of fifty pounds per annum.

Within a very recent period a petition, numerously signed, has been presented to the French Chamber of Deputies asking that a special tax on bachelors be established in France, and recalls the fact that the French revolutionary Convention of 1789, and some of the old republics, established such a tax. The petition further stated that the number of bachelors in Paris is nearly half a million, while the number of married men is not more than 379,000; and "that such a tax ought to be doubly welcome in France: *first*, because it will increase the declining population of the state by inducing bachelors to marry; and, *secondly*, because it will help to make up a growing deficiency in the national budget." In Switzerland, in the assessment of an income tax and taxes on dwelling houses, certain deductions allowed to married persons with families, are not allowed to bachelors or childless married people.

Legislation looking to the taxation of bachelors has also been seriously proposed of late in several of the States of the Federal Union. In Illinois, for example, a bill has been introduced in its Legislature imposing a uniform tax on all single men, sound in mind and body, above thirty-two years, who are not able to show that they have proposed marriage three times—and been rejected. The proceeds of the tax are to go toward establishing a home for worthy and indigent single women above the age of thirty-eight.

A Missouri bill makes the tax progressive, increasing by successive increments as the bachelor persists in his state of single blessedness.

In modern times (1848) an English Governor of Ceylon—Lord Torrington—undertook to repeat the experience of his countrymen of near five centuries before, by imposing a poll tax of three shillings per annum, or one week's labor, valued at three shillings, from every man, rich or poor, in the colony. This exaction, in point of inequality, was worse than the poll tax of Wat Tyler's time, inasmuch as it made the average income of the poorest laborer the standard according to which the rate of taxation was to be established for all. There was also another curious feature connected with this experience. The Cingalese priesthood were held liable to pay this tax, either in money or a week's work, when their religion required that they must neither perform work nor possess property. The result was a revolt attended with much bloodshed, an abandonment of the tax, and the recall of the Governor.

In one of the states of Central America a poll tax was recently required to be paid monthly; all adult male inhabitants of the several towns and cities being obliged to present themselves at the municipal treasuries and pay their dues in person.

In the colonial period of our history the poll tax was enacted by nearly all the North American colonies at one time or another. In Virginia and Maryland it was for a long time the only direct tax; and in the latter State it was imposed upon all free men and free women, and upon all free children over twelve years of age; and was rendered particularly odious and burdensome from the circumstance that its payment was required in tobacco, a given number of pounds to the head, the value of which commodity was not constant, but varied with supply, which at times was intentionally restricted, with the intent of augmenting its market price. There was, however, another side to this experience. The poll tax in the two States named was almost a measure of necessity. Land was of small value, for there was in the new colonies little distinction between improved and unimproved lands. Slaves were not taxable as personal estate, but belonged to the land and figured as real property; and the personal estates of the planters were comparatively small. Polls were therefore the most available measure of taxation, and tobacco was the currency of the day. All bills and charges were made out in so many pounds of tobacco; all lawyers' and court fees were so determined; the parish and county levies were fixed in weights of tobacco; and the minister drew as his salary so many pounds of tobacco from each parishioner, without respect to the market value of the crop. It accordingly happened that a poll levy might be excessive one year and nominal the next; with lawyers, ministers, and clerks rejoicing in abundant means one season and reduced to starvation point the next. Unequal, in proportion to wealth of the payer, as such a poll tax was, its inequality was furthermore greatly aggravated by fluctuations in the exchangeable value of the medium in which it was payable.

During the colonial period also, in North America, men's persons were included in the schedules of property made in reference to taxation; and instead of having a fixed sum, as was subsequently the rule in assessing a poll tax, the value of the poll was rated according to the earning capacity of the individual; and if he was old and infirm, or in any way disabled, the value of the poll was placed at a small amount.

Possibly by reason of English and American colonial experiences, and perhaps from an infiltration as it were, down through the ages, of the fact that in Greece and Rome the poll tax was exacted only of the people of subjugated provinces, and was therefore regarded as a mark of inferiority or slavery, this tax in modern times has not been in accord with public sentiment, and in most countries has now been abandoned. The last poll tax in England was enacted in 1689. Like all its predecessors, it was always unpopular and was regarded as unsuited to the people of England. It was repealed in 1698, and "henceforth this form of tax passed into the list of taxes tried and never again to be imposed in England. What minister," said Henry Fox in 1748, "would presume again to suggest the hated hearth money of the Stuarts, or the poll taxes of the reign of William III?" (Dowell, Taxation in England, vol. ii, p. 49.)

In the United States the poll tax formed, in 1895, a part of the tax system of twenty-six of the States and Territories, and was not recognized in twenty others, and in some of the latter its levy is prohibited by constitutional provisions. In New York a general law for the incorporation of villages confers upon its trustees the power to raise money by levying a poll tax.

From a theoretical or purely economic point of view the present popular opposition and adverse sentiment to the poll tax in the United States do not seem to be warranted by any very good reasons. The arguments made use of by those opposed to its continuance are not derived from old-time precedents, or warranted by the experience of foreign countries, inasmuch as its assessment in the States of the Federal Union has always been inconsiderable in amount, and has rarely involved in its collection any inquisitorial or arbitrary measures. The one most deserving of attention has been, that it practically imposed a property qualification upon the right of suffrage by making its payment a prerequisite to the act of voting, a money payment of even so small a sum as two dollars per annum in Massachusetts and one dollar in Connecticut being regarded in that light. But in answer to this it may be said that paupers are disfranchised not because they are vicious or illiterate, but, because of their inability to support themselves or aid in supporting the State, it is held that they ought not to be allowed a voice in the government of the State. To be consistent, therefore, the advocates of the abolition of the poll tax as administered in New England ought also to connect with it—i. e., its abolition—an extension of suffrage to the inmates of poorhouses who, otherwise qualified for its exercise, are now debarred from it exclusively by a lack of property qualification. On the other hand, a leading argument in favor of its continuance is that the majority of citizens who pay no direct State taxes upon property of any kind, but who are self-supporting and not paupers, ought not to be exempt from *directly* contributing to the support of the government, and this argument may be amplified and illustrated as follows: Thus, there is no citizen, be he ever so humble, who is not vitally interested in the preservation and welfare of the civil society of which he is a member; and it is of the first importance, more especially as the tendency of the age seems to be antagonistic, that each member of society should be encouraged to realize at all times his personal interest in the well-being of the State. To the rich man society comes and exacts a contribution in some proportion to his means, and as a consequence he has inducements to directly interest himself in the fiscal management of the government. To the poor man, who is otherwise rarely *directly* confronted with the tax gatherer, society comes also, and, in common with all citizens of a certain age, asks a very small annual contribution for the support of the State, because each citizen is interested in its existence and welfare, has a measure of responsibility resting upon him, and should be made to realize that responsibility. In the fact, therefore, that the poll tax touches directly every citizen and is an effective agency for awakening him to a sense of his political duties and responsibilities, and so better qualifies him for the exercise of the right of suffrage, is to be found the true reason for the incorporation of a small annual poll tax into every correct system of State taxation.

As has already been pointed out, a poll tax, having regard solely to the person and not to his property, is the only tax to which the term *personal* can be rightfully applied. It is the essence also of every free and just government that every person—the most humble as well as the most exalted—is equal before the law, and has a right to invoke the sovereignty of the State in all its fullness for the protection of his person. Keeping these two points in view, it would further appear that a poll tax assessed equally upon all citizens, and free from all discrimination, represents the most perfect equality of service, and is the only tax which a citizen can pay which can be regarded in the light of a *reciprocal* for the service which the State renders to him in protecting his person, all other taxes being in respect to property or business.

As the Constitution of the United States also excludes from representation "Indians not taxed," it would seem to imply that its authors regarded the exercise of suffrage by a citizen that was not a pauper and paid no direct tax, as an anomaly not likely to occur under a government founded upon equal public rights and responsibilities, and also that a citizen who did not pay any direct tax to the State was not likely to have any more correct idea or measure of his true relation to the State than a wild Indian.

If, however, public sentiment in any community is so adverse to the levy of moderate poll taxes that their collection is not and can not be enforced with any degree of uniformity and equality, as is reported to be the case in many States, then the advisability of their abandonment can not well be questioned, for the want of respect for all law, which always results from the maintenance upon the statute book of any law which a community will not regard or permit to be enforced, is an evil that far outweighs any possible good that can come from its continuance. Furthermore, the statement is probably warranted that in no instance in history has it been possible to enforce a permanent tax against which by common consent the public has revolted.

In considering the feasibility of its continuance it should not be overlooked that the tax upon property can be collected because the State holds a confiscatory power over the property to the extent of the tax. But the tax upon the non-property-holding polls can not be collected except through the consent of the assessed person, unless resort is had to the old law of imprisonment until payment is made—a remedy not likely to find favor.

The recent experiences of Massachusetts and Pennsylvania are especially worthy of note in this connection. The Constitution of Massachusetts, adopted during the Revolution, limited the suffrage to "every male inhabitant of twenty-one years of age and upward, having a freehold estate within the Commonwealth of the annual income of three pounds, or any estate of the value of sixty pounds." This restriction was abolished in 1821, but payment of a poll tax was still required before a man could vote. In recent years, however, this form of taxation has become so unpopular in this State, mainly by reason of a general belief that politicians, without distinction of party, were in the habit of collecting and disbursing large sums for the purpose of influencing or bribing voters by payment of their poll taxes, that in 1891 an amendment to the Constitution of the State was adopted which, while retaining the previous obligation of the payment of an annual poll tax, abolished such payment as a prerequisite for voting. The result was that before the adoption of this amendment from fifty-two to fifty-nine per cent of the poll tax due in the city of Boston was collected year by year; but since then the percentage of collection has fallen below forty-four per cent. Many of the city's own employees figure among the delinquents, and it has been found necessary to place hundreds of poll bills in the hands of the city treasurer for the deduction of the amount due from their wages. Leaving out the persons who can not pay without great sacrifice, it is stated that Boston is still losing above one hundred thousand dollars yearly in revenue from failure to collect the taxes upon polls that can and should pay. And this, in a modified form, is probably the situation throughout the State of Massachusetts.

In Pennsylvania the State Constitution makes the payment of a State or county tax, at least one month before election, a prerequisite to the exercise of suffrage; and as the poll tax involves the smallest amount of tax that a citizen could pay, it was expected that almost every man would pay it. But, in point of fact, it was found that thousands of citizens neglected to do so, and the political campaign committees, irrespective of party, recognizing this fact, have adopted the policy of furnishing voters whom they desired to influence with receipts for the payment of their poll taxes; and this practice has attained to such magnitude in recent years, that the two leading party organizations in the city of Philadelphia alone purchased in the year 1894 over ninety-five thousand such receipts. Obviously this is a form of bribery which is forbidden by the spirit if not by the letter of the law; and to meet such a situation of affairs the Legislature of Pennsylvania has recently (1897) enacted a law forbidding the payment of a poll tax by any other person than the elector against whom such tax is assessed.*

Neither of the judicial authorities above referred to seem to have grasped the great principle essential to the continuance of every truly free state—that the power of taxation should not be invoked for police purposes, but be strictly limited to the raising of revenue to meet legitimate state expenditures.

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* During the American colonial period some attempts were made to compel the exercise of suffrage by imposing a fine on citizens neglecting to vote at regular elections; the fine imposed in Maryland on citizens in default of such action having been one hundred pounds of tobacco. But since the adoption of the Federal Constitution no legislation of like character is believed to have taken place in any of the States until 1889, when Kansas City adopted a charter provision imposing a tax of two dollars and a half on each citizen who should fail to vote at a general election. This provision coming up for review before the State courts of Missouri, was affirmed in the first instance by a Superior Court judge, who took the ground that "in the enlightenment of the present age it is in the power of the State to compel its voters to exercise the election franchise, and if the State can do so the city is invested with the same power." After enumerating many things of an arbitrary nature that are done to maintain good municipal government, the judge said that he could see no legal objection to the use of the taxing power for the purpose of securing a full and perfect expression of public sentiment and the election of competent and worthy men to public offices. The position was an advanced one, he admitted, but not an unreasonable one, in view of the fact that "the highest type of government is attained when every voter casts his vote, and that vote is counted just as it is cast." On an appeal to the Supreme Court of the State, the provision was, however, declared unconstitutional, the language of the decision being as follows: "Taxes may be levied," it said, "in money or in services having a money value to the public, and he who pays in money does not necessarily have to pay more or less than he who pays in services, and *vice versa*, and it is upon this principle that these taxes are upheld; but who can estimate the money value to the public of a vote? It is degrading to the franchise to associate it with such an idea. The ballot of the humblest in the land may mold the destiny of the nation for ages."

"The man who will not buy a tax receipt, but expects his party to purchase it for him, is a bad citizen. He is, in effect, a person who is bribed, and who holds the value of his vote at a very small sum."—*Philadelphia Times.*

Of other terms employed to indicate different forms or methods of taxation, and a clear understanding of the meaning of which is essential to any correct discussion of the subject, the following are the most important:

DIRECT AND INDIRECT TAXES.—Taxes are generally characterized or classified as being either *direct* or *indirect;* but these terms, although in common use, are somewhat indefinite, owing to the inability of economists to agree as to their exact meaning; while in the United States this indefiniteness has been increased by the circumstance that its Supreme Federal Court has felt compelled by the language of the Federal Constitution to assign to the term "*direct,*" as applicable to taxation, a "*legal*" rather than an *economic* definition.

In a general sense the term *direct* is applied to those taxes which are demanded from the particular persons whom it is intended or desired shall pay them; and *indirect* to those which are demanded from a person with the expectation and intention that he shall indemnify himself for payment of the same at the expense of some other person.* There is, furthermore, a marked distinction, founded on sound philosophy, between a direct and indirect tax, which, if concisely expressed, will constitute two unimpeachable definitions. Thus an *indirect* tax, whoever may first advance it, is paid voluntarily and primarily (in the sense of ultimately) by the consumer of the taxed article. On the other hand, *a direct tax has always in it an element of compulsion;* not necessarily on the person who advances the tax in block, but on the person who is compelled to use or consume the taxed property or its product. For example, there is nothing compulsory or unequal in an ordinary license tax. If the license is high, no one is compelled to engage in a business covered by its legal requirement; and few persons will until the average profits of the taxed business by the regular laws of competition finally reach the average profits of other like employments or investments. A tax on commodities like whisky, tobacco, fermented liquors, oleomargarine, playing cards, dice, and the like, can always be avoided as a primary tax, or can be paid at discretion. But there is nothing voluntary in the payment of a tax upon *all* real or personal property, or on the income of such property. Human beings can not subsist without some forms of personal property, and therefore a tax upon all personal property or its income is of necessity compulsory and not voluntary. Any general assessments of personal property on or by reason of its income, as well as assessments on real estate, are unavoidable in their nature, and therefore, from a philosophic or economic point of view, are typically direct taxes. (See Alexander Hamilton's brief in the Carriage case, Hamilton's Works, vol. vii, p. 848.)

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* "In the assessment of indirect taxation, and such as is intended to bear upon specific classes of consumption, the object itself is alone attended to without regard to the party who may incur the charge. Sometimes a portion of the value of the specific product is demanded at the time of production—as in France, in respect to the article of salt. Sometimes the demand is made on entry, either into the State, as in the duties of import; or into the towns only, as in the duties of entry. Sometimes the tax is demanded of the consumer at the moment of transfer to him from the last producer—as in the case of the stamp duty, and the duty on theatrical tickets in France. Sometimes the Government requires a commodity to bear a particular mark, for which it makes a charge—as in the case of the assay mark on silver and a stamp on newspapers. Sometimes it monopolizes the manufacture of a particular article or the performance of a particular kind of business—as in the monopoly of tobacco and the postage of letters. Sometimes, instead of charging the commodity itself, it charges the payment of its price—as in the case of stamps on receipts and mercantile paper. All these are different ways of raising a revenue by indirect taxation; for the demand is not made on any person in particular, but attaches upon the product or article taxed."—*M. Jean Say, Treatise on Political Economy, 1821.*

The presence or absence of the principle of compulsion as constituting the essential difference between a direct and an indirect tax has not, it is believed, been before recognized by economists. And yet it is clearly involved or comprised in the definitions given by acknowledged authorities on the subject. Thus M. Leroy Beaulieu, in his *Traité de la Science des Finances*, characterizes those taxes "as direct which the legislator intends should be *paid at once* and immediately by him who bears their burden. They strike at once his fortune or his revenue, and every intermediary between him and the treasury is suppressed." McCulloch (Principles of Taxation) describes a tax "to be direct when it is *immediately* taken from property," and *indirect* "when it is taken from its owners by making them pay for liberty to use certain articles or exercise certain privileges." M. Say defines a direct tax to be the "*absolute demand* of a specific portion of an individual's real or supposed revenue." (Political Economy, p. 461.)

In the assessment of direct taxes a proportionality is generally sought between the person who pays and the value of his property, or ability to pay. Thus, in the taxation of watches, which are popular subjects for direct taxation, the proportionality between the owner who pays and the amount of property rated is recognized and maintained, by imposing, as in the city of Philadelphia, a tax of one dollar on watches of gold and one of seventy-five cents on watches of silver. In the assessment of indirect taxes the maintenance of any proportionality between the taxpayer and his fortune is not regarded. The idea of a *personal* assessment, which is characteristic of direct taxes, furthermore does not apply to indirect taxes, and the person upon whom the incidence of such taxation primarily falls may be regarded as advancing rather than paying the tax, which is ultimately paid by a consumer, not as a tax, but as a part of the market price of a commodity.

In other words, the general effect if not the avowed object of an indirect tax is to place its burden in a roundabout way on the person who ultimately bears it. Taxes on imports, or customs dues; most internal revenue taxes; "octroi" taxes, or taxes levied by municipalities on commodities—mainly articles of food—brought within their limits from without; stamps and fees for registering or verifying documents, are typical examples of indirect taxation.

The objections to this form of taxation are so great as to warrant their characterization as evils. In the *first* place, they prevent the taxpayer from knowing what he pays, by mixing up the price of an article with the tax, as has been already noticed. *Secondly*, they enhance the cost of a commodity to the consumer to a degree (often largely) in excess of the original burden of the tax. Thus, if an importer of sugar, salt, wool, coal, or metals pays taxes on these commodities when they enter the territory of another country (as, for example, that of the United States), he adds them to the first or invoice cost of the importation. On this aggregate he calculates and adds interest and profits when he sells to a wholesale dealer; and this process is repeated by every smaller dealer or retailer through whose hands the commodities pass on their way to final consumption; and as the number of such intermediaries is greatest in the case of articles sold by small retailers, the final burden of the tax is greatest on the very poor, whose necessities compel them to buy in very small quantities.* There is thus a very real and close connection between indirect taxation and pauperism.

In dealing with the relative influence of direct and indirect taxation, Mr. Gladstone, when Chancellor of the Exchequer, took the position in a parliamentary discussion in 1859 that "the distinction between them involves the question between rich and poor. All classes pay indirect taxation: the middle and wealthy pay direct; but indirect taxes press much more seriously on the laboring population."

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* Some years since, at the instance of the writer, the late Charles L. Brace instituted an examination to determine the difference in price to individual consumers of coal bought in comparatively large and small quantities. He reported that as a rule, when coal could be delivered at private residences in the city of New York (at the time when the investigation was made) for four dollars and a half per ton, its cost to the people whose poverty compelled its purchase by the "bucketful" was at least twelve dollars per ton. And yet when subsequently a philanthropic capitalist proposed to remedy this grievance of the poor by selling coal bought in small quantities at greatly reduced rates, his attempt did not meet with the full approval of the people whom he desired to serve, by reason of an inference by them that the project must in some way be a scheme for the promotion of private gain rather than public good.

An instructive comparison of the method and influence of direct and indirect taxation may be instituted by supposing the two systems to be put into practical operation under similar circumstances, for effecting a purpose which all are willing to admit is most desirable or necessary. For example, a town meeting is held to provide means for building a bridge. The direct and honest way would be to assess and levy an equitable tax, adequate to provide for the proposed expenditure, on the property of the citizens of the town. An indirect way, as exemplified by the tariff (omitting the complicated machinery for appraising merchandise), would be to provide that the storekeepers of the town should charge, on account of the proposed expenditure, an excess over general prices to the extent of two cents a pound on sugar, twenty-five cents more per yard on woolen cloth, five cents more for each tin pail or cup, and, keeping an account, return the results of the extra prices paid on the above-mentioned and other like commodities by their consumers, to the town treasury. Would it not be evident that under such a method of procedure the wealth of the town would in a great degree escape taxation for the construction of the bridge, and that its expense and burden would fall mainly upon the poor; inasmuch as the average amount of consumption of sugar, cloth, and tin by the citizens of the town, and the average *per capita* taxation contingent on the same, would have no just or uniform relation to their ability to pay for the same? A man with ten thousand a year income will not probably consume ten times as much sugar as one with one thousand a year.

In the case of imported commodities charged with import duties, not only is the price of the imported commodity enhanced directly by the duty, but the price of a much larger quantity of competing product of domestic origin is increased to approximately the same extent. Thus, in the case of iron and steel, the average difference in the prices of these commodities in England and the United States during the ten years from 1878 to 1887 inclusive, occasioned by the imposition of indirect customs taxes by the latter country on such a comparatively small proportion of its domestic consumption as was imported, increased the cost of the *total* consumption of these products in the United States during the period mentioned, to the extent of at least $550,000,000. Such an increase represented an average of $55,000,000 per annum in excess of the cost of a like quantity to consumers in Great Britain during the same period; an aggregate, according to the census data of 1880, in excess of the entire capital invested in the iron and steel industries of the country, including all its mines of both coal and iron.

An incident also illustrative of the character of an indirect tax was afforded some years ago when it was proposed in Washington to ex-Governor Warmoth, of Louisiana, as representative of the sugar-producing interest of that State, to substitute a bounty on domestic sugars in place of the protection afforded by the then tariff (taxation) on the importation of foreign sugars. The suggestion was repelled with no little warmth, on the ground that such a substitution would be most prejudicial to the domestic sugar industry. "The people," he said, "know that a bounty is a tax, and as soon as they found out its amount would insist upon its repeal, and thus the sugar interest would lose both the protection of the tax on foreign competitive imports as well as the bounty." How far subsequent events harmonized with this forecast by Mr. Warmoth is worthy of brief notice in this connection. Congress in 1891 entirely repealed all the tariff (tax) on the importation of raw sugars, and to compensate the domestic producers of sugar for the abrogation of the protection which had been previously given them, authorized the payment by the Federal Government of a bounty of from one and three fourths to two cents per pound on their product. In a little more than four years subsequently, when the effect of the bounty—aggregating over $30,000,000 and representing nearly the whole cost of producing the sugar entitled to bounty—had been fully recognized by the public, Congress repealed the act authorizing its payment without restoring the former protective duties; and with such a pronounced approval of its action on the part of the people of the United States as to render it almost certain that no Congress will hereafter authorize the direct payment of bounties by the Federal Government for any purpose.*

THE RELATIVE BURDEN ON TAXPAYERS OF DIRECT AND INDIRECT TAXATION.—Any discussion of this subject would be incomplete that failed to notice the estimates of the relative burden on taxpayers of direct and indirect taxation by persons well qualified by study, and administrative tax experience, to express an opinion.

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* The fundamental question involved in this sugar-bounty matter has never been passed upon directly by the Supreme Court of the United States; but the disbursement of the money voted by Congress for the payment of the sugar bounties having been withheld by the Comptroller of the United States Treasury on the ground that the appropriation was unconstitutional, the case came up before the United States Court of Appeals of the District of Columbia, which sustained the opinion of the Treasury official, and was adverse to the claim that "the general welfare" clause of the Constitution might be stretched to encourage the production of a commodity by a bounty. "If to Congress be conceded," it said, "the power to grant subsidies from the public revenues to all objects it may deem to be for the general welfare, then it follows that this discretion renders superfluous all the special delegations of power contained in the Constitution, and opens a way for a flood of socialistic legislation, the specious plea for all of which has ever been 'the general welfare.'" For further notice of this celebrated case see Chapter VII, Popular Science Monthly, p. 518.

It is not a matter of dispute that the cost of collecting direct taxes is, as a rule, much less than is the case with indirect taxes, and that of the receipt contingent on the former the largest proportion accrues to the Government. Thus in Prussia, where the administration of taxation may be characterized generally as despotic, the cost of raising revenue from direct taxes has been reported at four per cent and of indirect at twelve per cent. Under a direct tax system everybody knows how much he really pays, and if he votes for war or any other expensive national luxury, he does it with his eyes open to what it costs him. If all taxes were direct, taxation would be much more apparent than at present, and there would be a continuous popular demand, which at present there is not, for economy in public expenditures.

In England it has been estimated that for every *fifty* millions of indirect taxes paid into the exchequer, *seventy* millions are finally taken from consumers; and M. Guyot, late French Minister of Public Works, has recently shown by a series of statistical diagrams, that the *octroi* system of indirect taxation in France adds on an average twenty per cent to the cost of goods to consumers over and above the tax.* In New Zealand, where a comparatively small population and limited and definite sources of revenue have afforded extraordinary facilities for making an analysis, an expert has recently calculated that for every million and a half collected through the customs the people of that colony have paid not less than a million and two thirds.

In 1851 a committee of the Liverpool (England) Financial Reform Association published a statement, that a careful investigation instituted by it showed, that the difference between the net amount paid into the exchequer from indirect taxes and the gross amount taken through or in consequence of this system from the taxpayers, was not less than an average of thirty-seven per cent; and added that the evidence that had led to this conclusion "can neither be controverted as matter of fact, nor strengthened as a matter of argument."

In 1846 Hon. Robert J. Walker, then Secretary of the Treasury, in accordance with instructions from the United States Senate to report the extent to which the price of domestic products was enhanced by the then existing duties imposed on the import of competing commodities, submitted the following statement: "The revenue from imports last year exceeded twenty-seven millions of dollars, of which, twenty-seven millions are paid to the Government upon imports, and forty-four millions in enhanced prices of similar domestic articles. This estimate is based upon the position that the duty is added to the price of the import and also of its domestic rival. If the import is enhanced in price by the duty, so must be its domestic rival, for, being like articles, their price must be the same in the same market." (Senate Document, First Session, Twenty-ninth Congress, 1845–'46.) *

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* It seems incredible, he is reported as graphically saying, "that Frenchmen, usually so sensitive to ridicule, can quietly submit to be 'sweated' and 'plucked' like fowls, without crying out against this antiquated method of indirect taxation only so long as they are kept blind to the tax."

In a debate in the Constitutional Convention of the State of New York in 1867–'68, the late Hon. George Opdyke, a member, and one of the best economic and fiscal authorities of his time, stated that his investigations had led him to the conclusion that consumers of imported articles in the United States are "charged with at least fifty per cent in addition to the duties actually received by the Government."

As the result of a careful study of the subject, based on the rates of duty imposed by the tariff law of March, 1883, Hon. William H. Springer (for a long time a prominent member of Congress) was led to the conclusion that the average increase in the prices of domestic commodities due to the duties imposed on the import of competitive products had not been less than $556,000,000 for every year of the twenty years next precedent to 1883, "making an aggregate of over eleven billions of dollars, not one dollar of which went into the national Treasury." (See North American Review, vol. cxxxvi, No. 319.)

The experience of the indirect taxation of commodities also shows that they favor the concentration of business in a few hands, or the creation of monopolies. Of this the experience of the internal revenue system of the United States has furnished some curious examples. Thus a tax was imposed in 1864 on matches at the rate of one cent per package of one hundred or less; and, although comparatively insignificant, it yielded at one time, by reason of the immense number of matches consumed, an annual revenue of over $3,500,000, which sum the manufacturer was obliged to advance by purchasing and affixing stamps to each package as a prerequisite to selling. To manufacturers furnishing their own design for the stamp, the Government allowed a discount of ten per cent on stamps of an aggregate value in excess of five hundred dollars purchased at any one time, and sixty days' credit to such manufacturers as could offer satisfactory security

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* This estimate was founded on an apparently careful investigation of the prices "of sixteen leading domestic articles and the manufactures thereof, similar to those on which the present duties (1845) are imposed."

(i. e., in the form of United States bonds) for their payments. Under such circumstances small manufacturers with a limited capital were crushed, and the business of manufacturing concentrated in a very few firms, which raised the retail price of matches to an extent considerably in excess of the amount of the tax. In later years (1883), when it was proposed to repeal this tax, the singular spectacle was afforded of the larger manufacturers strenuously exerting themselves to influence Congress to prevent the repeal, and asking that they might continue to be taxed. Their efforts were, however, unavailing. The tax was abolished, and the retail price of matches immediately declined more than fifty per centum—i. e., from fifteen cents to six cents for six boxes.

Many years ago the late Henry C. Carey characterized indirect taxation in the following forcible and figurative language: "The whole system of indirect taxation," he said, "is mere petty larceny. It is an attempt to filch that which can not be openly demanded. It is one of those 'inventions' of man by which the few are enabled to grow rich at the expense of the many, and is therefore greatly favored by that class of men who prefer living by the labor of others to living by their own. The man who plunders a city is of the same species with the highway robber. The one who imposes indirect taxes is of the same species with the *chevalier d'industrie.* All belong to the *genus* of great men. All are equally destitute of manly or generous feeling. The plunderer of cities selects those which are weak and defenseless, and the collector of indirect taxes selects the commodities used by poor men who can not defend themselves; and where the system most prevails, men are most weak and cheap and food most dear."* (H. C. Carey, Past, Present, and Future, pp. 464, 465, Philadelphia, 1848.)

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* "So long as it (indirect taxation) shall be permitted to exist, depopulation, and the system of large revenues, raised by means of indirect taxation, to be squandered by those who live by managing the affairs of others, must continue. So long as it exists, the planter and farmer must continue to give a large portion of their small product in exchange for a small quantity of clothing. So long as it exists, every attempt at the establishment of freedom of trade must be a failure. With its correction, every obstacle to the establishment of perfect freedom will disappear, and the tariff will pass out of existence. The interest of every farmer and planter, and of every laborer and mechanic, is directly concerned in the adoption of a measure that shall be calculated to promptly produce the effect desired—i. e., repeal of indirect taxation—but it is not more his interest than his duty. So long as the present system shall continue, trade of every kind must be subject to violent fluctuations which enable the few to enrich themselves at the expense of the many, and enable gambling speculators to live in palaces and ride in coaches by aid of indirect taxation levied upon the hard-working mechanic and honest trader, ruined by changes in the value of their property. It is, therefore, the bounden duty of every man desirous to promote the great cause of morality, justice, and of truth, to unite his efforts with those of his neighbor for the early accomplishment of this great object."—*H. C. Carey, Past, Present, and Future, pp. 471, 472, Philadelphia, 1848.*

And yet Mr. Carey's name, more than that of any other citizen of the United States, is identified with a system of raising revenue which is based exclusively on indirect taxation.

Mr. Henry George, in one of his essays, also thus forcibly makes clear a leading characteristic of the indirect taxes levied by the Federal Government: "Propose," he says, "to abolish, or even reduce, one of these taxes, and Washington will be filled with lobbyists begging and working for its extension. What does this mean? It means that these taxes yield revenue to private parties as well as to the Government."

Carlyle was not far out of the way in characterizing legislators who advocate indirect taxation as having a purpose, "that those who are not hungry should suppress those who are. The pigs are to die—i. e., be subject to taxation—no conceivable help for that; but we, by God's blessing, will at least keep down their squealing!"

The question of the relative merits of the two systems of taxation under consideration, has long been—since the days of Jeremy Bentham—a subject of discussion, with a trend of popular sentiment unmistakably in favor of indirect, or it should rather be said in opposition to direct taxation.*

What satisfactory explanation can be given for a conclusion so clearly adverse to public interest? John Stuart Mill has attempted it as follows: "The feeling is not grounded on the merits of the case, and is of a puerile kind. An Englishman dislikes not so much the payment as the act of payment. He dislikes seeing the face of the tax collector and being subjected to his peremptory demand. Perhaps, too, the money which he is required to pay directly out of his pocket is the only taxation which he is quite sure that he pays at all. That a tax of two shillings per pound on tea, or of three shillings per bottle on wine, raises the price of each pound of tea and bottle of wine which he consumes by that and more than that amount can not indeed be denied. It is the fact, and is intended to be so, and he himself is perfectly aware of it; but it makes hardly any impression on his practical feelings and associations, serving to illustrate the distinction between what is merely known to be true and what is felt to be so."

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* "We find, as the result of our examination and contrast, that direct taxation is, in every essential feature, vastly superior to our present method; that the former accords with justice, economy, and all the other requirements of a sound policy; while indirect taxation violates every principle on which legislation should be based. It must be owned, however, that notwithstanding the weighty objections to the one and the economy and perfect fairness of the other, there are few of our citizens who are desirous of making the proposed change. Direct taxation is a phrase that grates on the nerves of all. Men start at its sound as though it was a portent of evil; something which had impressed them with deadly fear. They seem to regard it as deeply imbued with the spirit of tyranny, to say the least, if not as the most forbidding impersonation of that monster. So unpopular is this method of taxation, that an aspirant for public station or honors would as soon think of committing high treason as propose or advocate it; and if his ambition were bounded by the present, he would be right, for he could not more effectually destroy his popularity."—*Treatise on Political Economy, by George Opdyke.*

Mr. Mill also expressed the opinion that men's minds are so little guided by reason on this subject that if it was attempted to raise all the imperial revenue of Great Britain by direct taxation, the dissatisfaction on the part of the people at having to pay so much would be extreme.

Speaking on this subject in the House of Lords in 1860, the Earl of Derby said that "by making the whole revenue of the United Kingdom depend upon direct taxation the pressure would be so odious that wars would be avoided, because no party would incur the odium of carrying them on."

There can be no doubt that high direct taxes, making evident to the most unobservant citizen the excess of burden imposed upon him, have been the prime cause of the repudiation of public debts in the United States, and the arrest or ruination of internal improvements of great importance.

Mr. George Opdyke, in his Treatise of Political Economy, advanced the idea that the phenomenon of preference for indirect taxation in the United States might be accounted for in part by the fact, that the unjust manner in which taxes were levied by Great Britain on her American colonies engendered in the public mind of their people "a deep-seated hatred of every form of taxation; and the direct being its most visible or sensible form, it has been mistaken for the worst—an impression that was strengthened when the most unpopular of our Presidents (the elder Adams) recommended this policy, and when the opposing political party, seizing the occasion to profit by public prejudice, represented it as the worst form of tyranny." *

An economic phenomenon in connection with this subject goes far to support the idea that political economy can not be an exact science, inasmuch as it is largely or wholly based on human action, concerning which nothing certain and invariable can be

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* An acute economic student and observer writes as follows on this subject: "I have been very much struck by the apathy of taxpayers to the increase of taxes in their most direct form. Take Philadelphia, for example. Nearly every man owns a house there, and yet there seems to have been no objection to the grossest municipal extravagance, entailing heavier and heavier burdens every year. The city to-day levies about ten times as much per head as it did thirty or forty years ago. The exact figures would be easy to get, and would certainly point a moral adverse to your view that direct taxation is twin brother to public economy. I am inclined to look for an explanation to the fact that real estate values have steadily risen, so that after all the increase of taxation has been easily met."

predicated. Thus the argument and evidence are complete that it is not a wise, humane, or perhaps a moral policy for a state created or maintained for the purpose of promoting the interests of its people to adopt a system of indirect taxation for the raising of revenue; and, furthermore, that it is contrary to human nature for a people to desire or be willing to pay more for any service or commodity than it is intrinsically worth; or, what is the same thing, perform more work in return for the same than is a fair equivalent. And yet both governments and the people in all countries and at all times (including the present) have shown a preference for this system of taxation over any other.

One explanation of this curious inconsistency is as follows: It is and ever has been the aim of all governments to avoid responsibility and occasion for popular criticism in respect to their financial policy; and a direct tax is an annual reminder to their citizens or subjects of the burden of government, and prompts them to hold the government to a strict accountability. Under a free or popular form of government a general system of direct taxation would practically call for an annual judgment of the voters on the fiscal policy of an administration in power, and such a tightening of the purse-strings as would reverse such policy in case of its popular disapproval. But with a system of indirect taxation, as a tariff on imports, a government can undertake the most unnecessary and extravagant measures and obtain revenue sufficient to defray its contingent expenditures without general popular disapproval.

Indeed, the best defense that can be offered for the continued resort to indirect taxation is, that with the present large demands on the part of all civilized states for revenue to meet increasing fiscal obligations, mainly incurred for war expenditures, past and present, and the unwillingness of the people to pay direct taxes, it would be practically impossible to maintain the modern government without large contributions from people of limited resources; and that this purpose can only be accomplished by taxing them indirectly. On the other hand, it may be replied that if direct taxation was alone made the agency for obtaining revenue, unnecessarily large expenditures through the resistance of the masses would not be possible. In like manner, if the present indirect taxes levied on imports by the United States were to be replaced by direct taxes, collected in money or in kind from purchasers for final consumption, on whom the burden in both cases finally rests—if every person buying silk or sugar were stopped by a government tax gatherer at the door of the place of purchase and thirty per cent of his purchases taken in kind in one case and fifty per cent in the other in payment for taxes, it is safe to say that such a system would not continue operative any longer than would suffice for the people, through legal methods, to compel its modification. One explanation—i. e., of inconsistency—on the part of the people who pay taxes is, that although the benefits derived from the institution of government (which practically can not exist without taxation) are of the first importance, they are not so very obvious, nor so striking, as to be readily recognized and appreciated by the masses, who are accordingly apt to look with complacence upon a direct (personal) demand for a tax in the light of a compulsory payment, for which no equivalent is returned. Indeed, this feeling is so strong that it has become an almost popular maxim in all countries that "there is nothing which a person so hates to do as to pay taxes," in case they are direct. But by the ingenious plan of taxing articles on which incomes are expended, rather than openly demanding a portion of the income itself, the amount of taxation is concealed from the mass of taxpayers, and its payment is made to appear in some measure voluntary. The indirect tax being generally advanced rather than paid, as has been already shown, in the first instance by the importers, the ultimate purchasers for consumption confound the tax with the natural price of the commodity. No separate demand being made upon them for the tax, it escapes their consideration, and the article which they receive seems the fair equivalent of the sacrifice made in acquiring it. Indirect taxes have also the advantage of being paid by degrees, in small portions, and at a time when the commodities are wanted for consumption, or when it is most convenient for the consumer to pay them." *

In the attempt, furthermore, of civilized rulers to maintain a civilized government over an uncivilized people, there seems to be no practical method of compelling such a people to help maintain a proper and desirable government except through a resort to indirect taxation. Thus, in British India, a country of low civilization, small accumulation of wealth, and under such climatic conditions as necessitate the minimum of clothing, shelter, and food, the only way by which the mass of the native population can be compelled to contribute anything whatever, apart from a tax on land in the form of rent, toward the support of a government whose beneficent and civilizing influence has become a matter of history, is by the taxation of salt, the consumption of which is a necessity to all, and the production and distribution of which can in a great measure be controlled.

In the British island and colony of Jamaica, populated mainly by emancipated blacks and their descendants (557,132 out of a total of 580,804 in 1881), who own little or no land, and consume

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* J. R. McCulloch. Taxation and the Funding System.

little of food other than what is produced almost spontaneously, the problem of how to raise revenue by any form of taxation for defraying the necessary expenditures of the Government has been one of great embarrassment. For the year 1884 these expenditures averaged three dollars and forty cents per head of the entire population, and of this amount an average of about fifty cents per head could only be obtained from any internal taxation, and this mainly through the indirect agency of licenses and stamps, and not by any direct assessment. The balance of required revenue was obtained from a special tax on some set manufacture, and from export and import duties. A similar state of affairs in Mexico, heretofore noticed somewhat in detail (see vol. xlix, No. 1, pages 45, 46), would also seem to necessitate a resort to a system of indirect taxation.

It is interesting to note, in connection with this subject, that while the States and municipal governments of the Federal Union derive their revenues almost entirely from direct taxation, the national revenues flow almost wholly from indirect taxes on commodities or personal property.

Attention is here also particularly directed to a fact that has almost entirely escaped the notice of economic and fiscal authorities and writers, and that is the remarkable change that has taken place within the last fifty years in the British tax system, whereby, through an extensive substitution of direct for indirect taxation, the burden of tax incidence has been shifted to a great extent from the community at large to the propertied classes. Thus, in 1841–'42, indirect taxes yielded seventy-three per cent and direct taxes twenty-seven per cent of the total imperial revenue, but in 1895–'96 indirect taxes yielded fifty-two per cent and direct taxes forty-eight per cent. Is not the inference warranted, that in the change in the incidence of British taxation above noted is to be found at least a partial explanation of the remarkable and progressive increase, in comparatively recent years, in the consumption of the various commodities that enter into the living of the laboring classes of Great Britain, and is it not also singular that the above facts and their possible inference do not as yet seem to have attracted the attention of those most interested in social economics ?

[*To be continued.*]

THE Mazamas is the name of a society of mountain climbers organized on the summit of Mount Hood in 1894 for the promotion of mountain exploration, the protection of forests and scenery, and the acquisition and dissemination of knowledge concerning these things. The qualification for membership is the ascent of a recognized snow-cap peak. The meeting at which the society was organized was attended by 193 people, who ascended 11,225 feet for the purpose.

SUICIDE AND THE ENVIRONMENT.

By ROBERT N. REEVES.

IN the discussion of the increase of suicide in the United States, a great deal has been said in the consideration of the act as a crime, but little, comparatively, in reference to its causes or to those preventives which society has power to enforce. Dr. D. R. Dewey, who some years ago made a careful study of the question as it related to the New England States, declared that since the year 1860 suicide had increased in those States to the extent of thirty-five per cent. This percentage, with but slight variations, will probably apply to all other States of the Union where there is great industrial and commercial activity.

Suicide is so violent a reversal of that strongest instinct of Nature—the instinct of self-preservation—that its causes and preventives will always be the subject of deep and careful investigation. If it is on the increase, there must be causes for its increase, and these causes being ascertained, it is then our duty to devise means for its prevention. Insanity, heredity, financial reverses, and domestic complications may be direct incentives to suicide, but back of them all is the real cause—the growth of a nervous, disordered temperament in the American people. The steady habits of our colonial ancestors no longer satisfy us, and, as a consequence, those amusements, those ventures and schemes which excite the mind and nervous system to the highest degree are becoming more and more prominent. This, no doubt, is the fundamental cause of all suicide. But it is only with the direct incentive that society is capable of dealing, and these direct causes are so numerous and varied that it is almost impossible to classify them with any degree of accuracy. The individual may be impelled to self-destruction by circumstances, by an innate craving or instinct, by an uncontrollable impulse, by the unhealthy reasoning of a disordered intellect, and by many other influences. Suicides may therefore be divided into two great classes—those in which reason is called upon to decide between life and death, and those which are due to impulse or insanity. In the former class the self-destroyer has, after reasoning upon his condition, come to the conclusion that death is the most acceptable of impending evils. In this class may be placed all those suicides due to sickness, financial embarrassment, ungratified ambition, the desire to escape justice, and causes of a like nature.

Among the second class, or those self-murders which are the direct or indirect outcome of insanity, may be included all cases of persons who are impelled to destroy their lives when insane, of those who commit the act on some trivial cause or provocation or from imitation, of those who while sane give way to sudden impulse, and of those who, after a longer or shorter struggle, succumb at their own hands to a growing impulse. Civilization, drunkenness, imitation, and hereditary propensities are accountable for much of the self-destruction prevalent; and so, to a greater or less extent, are age, sex, the state of health, and daily occupations of the victim.

Attempts have been made to prove that climate has an effect upon the rate of suicide, but these attempts have never done more than show that the temperate regions have the highest ratio. This, of course, is not due to the climate, but to the more complicated civilization, the greater physical and mental wear, and the more extensive interference with natural laws met with in the temperate regions. While it is true that climate exerts but little influence over the rate of suicide, the seasons, on the contrary, do strongly affect it. The popular belief is that suicide is more frequent during the months of winter and spring. This, however, is incorrect. Cold, wet, damp weather does not, as so many people suppose, promote despondency and suicide. Strange as it may seem, at that period of the year when the sufferings of the poor and the sick are least, when employment is most readily obtained, when the pleasure of living should be at its highest, suicide is most frequent. May, June, and July, the months of song and sunshine in all countries, give the greatest number of self-murders. For this there is no satisfactory explanation, unless we accept that of the medical fraternity, which is that during the period of early summer the organism is working at a higher tension, every function of mind and body is more active than at any other period of the year, and consequently there is greater liability to sudden physical and mental collapse.

The sad fact that suicide and education increase at an equal rate is now generally admitted. Civilization does not free humanity from grief, disgrace, and disappointment; but wherever civilization is highest the struggle for existence is fiercest, life is most artificial, and there the most failures of the human race are met with. There was a time in Roman history when suicide was almost epidemic. It was when the great republic had reached its acme of civilization—when poetry, art, and eloquence were triumphant. It is probable that the proportion of suicides due to mental derangements is increasing, but how rapidly can never be exactly determined. Morselli says that about one third of all suicides may be attributed to insanity.

Many people, however, anxious to stamp the act with reprobation, declare that every suicide is insane. This is wrong. While those who bring about their self-destruction may have acted wrongly or unwisely, we have not the right to declare them all insane. It is true that many persons brood over their troubles until everything loses proportion, their minds become unbalanced, and in such a state they kill themselves. In such cases the act may be correctly attributed to insanity. But what are we to say of those who are to all appearance rational and yet are the victims of sudden or growing impulses? Such people are not voluntary agents, and yet they can not be called insane. They are abnormal. There is a fatal defect in their organization which is incompatible with their survival under natural conditions. This defect may give rise to sudden impulses or may cause a growing gradual propensity which terminate in the final tragedy. Instantaneous impulses are often brought about by the slightest circumstances. Thus, gazing steadily at the wheels of an approaching train or looking down from some great height may produce a delirium, a distention of the blood-vessels of the brain, that instantly paralyzes the will of the victim.

In the consideration of those propensities which are of gradual growth we are confronted with an extremely difficult problem. We know that a great many of those who ultimately destroy themselves fight for years against the impulse. How are we to account in such cases for the persistence of the tendency toward suicide, which seems to be a part of their nature, a part which draws them instinctively to death just as the normal creature is drawn to a desire to live? For such cases heredity may be in a great measure responsible. It is clear that hereditary influences may reveal their force in the suicidal impulses as in many other of the problems of life.

Whole families have been known to kill themselves. There are a great many human beings who by nature are predisposed to self-destruction, and only wait through life for a calamity sufficiently great to prompt them to the act. They are victims of their own faulty organizations.

Individual temperament may have a great deal to do with the question of suicide. In America the population is largely composed of the various European races, and although these are living under the same conditions, each nationality retains its own peculiar rate of suicide. Drink and crime are responsible for a large proportion of the daily self-murders. Drunkenness, the most active agent of degeneration known, is directly responsible for those which occur during a period of nervous depression following a debauch. Among the criminal classes suicide is quite common, but it is among the petty and not the grave offenders that it occurs. Poverty and disease are also strong incentives to self-destruction. Suicide is often regulated by the price of bread. Life has few pleasures for the homeless and friendless. Death to them is often a welcome friend, a happy relief from walking the streets hungry.

How many suicides are directly attributable to disease can not be stated with exactness, but it may be said, nevertheless, that at the present time, with our advanced skill in surgery and medicine, suicide from disease is undoubtedly on the decrease. Of all suicides there are none to be pitied more than those who kill themselves to escape the racking pain of an incurable illness. For the victim of this sort there is no hope. Another class of suicides, which closely resemble those caused by disease, includes those due to infirmity. Often persons smitten with blindness, or who have met with some terrible accident, in a fit of discouragement kill themselves. Those blind or deformed from birth, however, seldom resort to suicide. Not knowing the pleasure of sight or limb, they go through life contented.

The theory that we hold more strongly to life as we approach its natural conclusion is contradicted by statistics, which everywhere show that the last half of life exhibits a great increase in the rate of suicide. And here it may be pointed out that as to the age of greatest frequency, suicide and crime are diametrically opposed. While suicide attains its highest rate after the prime of life is past, crime, on the contrary, reaches its highest point between the ages of twenty and thirty years. We remark, further, the alarming increase in late years of what is called child-suicide. It is here that education strongly asserts itself as a true and exciting factor, for it has been shown that in those countries where what we are pleased to call education is rigorously forced upon children, there child-suicide is most frequent. And for this system of forced education there is no excuse. It is terrible in its consequences. To increase the strain to just below the collapsing point is not to educate. It only serves to fill the world with nervous, neurotic, morbid beings.

Another cause of the increase of child-suicide is the fear of physical punishment. Instances of children destroying themselves because of punishment or the fear of threatened punishment are constantly recorded in the public prints. Repeated cruel punishments will often extinguish, even in the healthy child, the love of life so characteristic of youth. What, then, are we to expect of poor, devitalized children subjected to the cruelties of barbaric parents ?

At the present day man is much more prone to suicide than woman. This is true of man in regard to epilepsy, crime, and other marked signs of degeneration. But it has been observed that as woman approaches man in her mode of life she also becomes more familiar with those abnormal conditions which have previously been peculiar to man. The comparative immunity of woman from self-destruction in the past has depended greatly upon the relatively less harassing part she has taken in the struggle for life. To-day it is different. Now woman occupies the fields of art, literature, finance, and even politics, and, as she goes deeper into these vocations, she must expect to suffer the consequences. Already it is noticeable that feminine suicide is not now entirely due to the sentimental causes of disappointed love, desertion, and jealousy, but to those trials of a more material order such as have led men to the act of self-destruction.

Imitation far exceeds any other of what are called "trivial causes" of suicide, and asserts itself more in woman than in man. It is much more common than is supposed. When self-destruction becomes epidemic, as it sometimes does, its prevalence very largely depends upon imitation. It is said that many years ago the wail of Thomas Hood over The One More Unfortunate brought many a sentimental person to a watery grave in the Thames. And in our own day the vivid representation of suicide upon the stage under conditions appealing forcibly to the imagination has been known to be followed by the self-imposed death of persons whose conditions resembled closely those of the suicide in the drama.

The daily papers are largely responsible for this class of suicides. It can scarcely be doubted that the general diffusion of newspaper reports familiarizes too much the minds of the people with suicide and crime. A single paragraph, a chance expression, a cause given which resembles that of the circumstances surrounding the reader, seizes the imagination, and in a morbid excitement the desire to repeat the act is born. Newspaper reports further promote suicide by inflaming the passion for the notoriety which will be conferred upon the perpetrator through their accounts of the act.

Has city life any influence over the proportion of suicides? This question must be answered in the affirmative. Where the population is dense and the laws of health are neglected, where dirt is common and vice flourishes, where the poor are concentrated, and where fortunes are made and lost in a day, will always be found the highest rate of suicide. It is in the poorer districts of our large cities that suicide is most frequent. In these districts the deprivations of light and air, the poverty, the diseased conditions about them, render the poor moody, morbid, and despondent, and raise in their minds a feeling that life is not desirable.

What can society do to prevent suicide among the poor? The obvious method would be to render their conditions more enjoyable by giving them ampler provisions for pleasure and recreation, making their surroundings more cleanly and agreeable, and by faithfully executing thorough and most effective sanitation. Proper sanitary and hygienic measures have a wonderful effect in renewing the vitality of our people. They are powerful agents for improving morality.

There probably never will be a time when suicide will be unknown in the world, but there are many preventives that are of value to-day. Religion has in the past been a powerful preventive. But this fear dies out as religion becomes broader. The fear of future punishment on account of self-imposed death is not now the preventive of suicide that it was fifty or a hundred years ago. The moral influences of family life naturally have a tendency to decrease suicide. Thus it has been found that in a million of husbands without children there were four hundred and seventy suicides, and in the same number with children there were but two hundred and five. Of a million wives without children one hundred and fifty-seven committed suicide, as against forty-five with children; widowers without children, one thousand and four; with children, five hundred and twenty-six; widows without children, two hundred and thirty-eight; with children, but one hundred and four. These figures are eloquent pleaders in favor of family ties as conservators of life. They prove distinctly that man must love in order to live.

Laws prescribing punishment for suicide are solecisms. If we wish to prevent suicide we must change conditions for the better, not for the worse. Suicide is beyond the reach of the criminal code. Its prophylactic must be founded, not upon a statute, but upon a wise and judicious management, medical, moral, and philanthropical, of those unfortunate enough to attempt their lives. It would be far better and more humane to sweep away all legislation upon the subject so far as it relates to the individual, and even take for granted that every person is insane who attempts suicide, than to punish their attempts by imprisonment. If the victim is insane, efforts should be made to restore reason; and if failure is met with, a sanitarium should be provided. Those who are sane should be reasoned with, calmed, and assisted.

Our hearts should be filled with tender compassion for those whose lives have been such as to become valueless to them. We should pity them. In the gentlest language possible we should condone and not condemn their act; for it is only with a spirit of sympathy and not of vindictiveness that we can hope to study with profit the causes and preventives of suicide.

THE RACIAL GEOGRAPHY OF EUROPE.

A SOCIOLOGICAL STUDY.

(*Lowell Institute Lectures, 1896.*)

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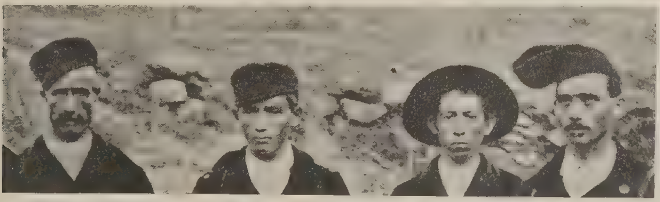
V.—THE THREE EUROPEAN RACES.

IT may smack of heresy to assert, in face of the teachings of all our text-books on geography and history, that there is no single European or white race of men; and yet that is the plain truth of the matter. No continental group of human beings with greater diversities or extremes of physical type exists. That fact accounts in itself for much of our advance in culture. We have already shown in the preceding papers that entire communities of the tallest and shortest of men as well as the longest and broadest headed ones are here to be found within the confines of Europe. Even in respect of the color of the skin, hair, and eyes, responsible more than all else for the misnomer "white race," the greatest variations occur. To be sure, the several types are to-day all more or less blended together by the unifying influences of civilization; there are few sharp contrasts in Europe such as those between the Eskimo and the American Indian or the Malay and the Papuan in other parts of the world. We have been deceived by this in the past. It is high time for us to correct our ideas on the subject, especially in our school and college teaching.

Instead of a single European type there is indubitable evidence of at least three distinct races, each possessed of a history of its own, and each contributing something to the common product, population, as we see it to-day. If this be established it does away at one fell swoop with most of the current mouthings about Aryans and pre-Aryans; and especially with such appellations as the "Caucasian" or the "Indo-Germanic" race. Supposing for present peace that it be allowed that the ancestors of some peoples of Europe may once have been within sight of either the Caspian Sea or the Himalayas, we have still left two thirds of our European races and population out of account. As yet it is too early to discuss the events in the history of these races; that will claim our attention at a later time. The present task before us is to establish first of all that three such racial types exist in Europe.

The skeptic is already prepared perhaps to admit that what we have said about the several physical characteristics, such as the shape of the head, stature, and the like, may all be true. But he will continue to doubt that these offer evidence of distinct races because ordinary observation may detect such gross inconsistencies on every hand. Even in the most secluded hamlet of the Alps, where population has remained undisturbed for thousands of years, he will be able to point out blond-haired children whose parents were dark, short sons of tall fathers, and the like. Our portraits of four Corsicans chosen at random offer a case in point. The people of this rocky island are as highly individualized as any in Europe. They offer the purest examples of the southern or Mediterranean type of Europeans; and yet these four men are quite different from one another. As the indexes show, the heads are quite unlike in their proportions. The man on the right is apparently broader-faced than either of the fellows next him, although he is relatively much longer-headed than either. The four vary considerably in the color of the hair and eyes. Nor in stature is there any greater apparent similarity. Such diversities confront us on every hand even in this retired corner of Europe. What may we not anticipate in less favored places, especially in the large cities?


72·3.
80·8.
80·1.
75.

Cephalic Index of Corsican Peasants.

Traits in themselves are all right, our objector will maintain: but you must show that they are hereditary, persistent. More than that, you must prove not alone the transmissibility of a single trait by itself, you must also show that combinations of traits are so handed down from father to son. Three stages in the development of our proof must be noted: first, the distribution of separate traits; secondly, their association into types; and, lastly, the hereditary character of those types which alone justifies the term races. We have already taken the first step: we are now entering upon the second. It is highly important that we should keep these distinct. Even among professed anthropologists there is still much confusion of thought upon the subject—so much so, in fact, that some have, it seems to me without warrant, abandoned the task in despair. Let us beware the example of the monkey in the fable. Seeking to withdraw a huge handful of racial nuts from the jar of fact, we may find the neck of scientific possibility all too small. We may fail because we have grasped too much at once. Let us examine.

There are two ways in which we may seek to assemble our separate physical traits into types—that is, to combine characteristics into living personalities. The one is purely anthropological, the other inferential and geographical in its nature. The first of these is simple. Answer is sought to a direct question. In a given population, are the blondes more often tall than the brunettes, or the reverse? Is the greater proportion of the tall men at the same time distinctly longer-headed or otherwise? and the like. If the answers to these questions be constant and consistent, our work is accomplished. Unfortunately they are not always so, hence our necessary recourse to the geographical proof: but they at least indicate a slight trend, which we may follow up by the other means.

Let it be boldly confessed at the outset that in the great number of cases no invariable association of traits in this way occurs. This is especially true among the people of the central part of Europe. The population of Switzerland, for example, is persistently aberrant in this respect; it is everything anthropologically that it ought not to be. This should not surprise us. In the first place, mountainous areas always contain the "ethnological sweepings of the plains," as Canon Taylor puts it. Especially is this true when the mountains lie in the very heart of the continent, at a focus of racial immigration. Moreover, the environment is competent to upset all probabilities, as we hope to have shown. Suppose a brunette type from the south should come to Andermatt and settle. If the altitude exerts an influence upon the pigmentation, as we have sought to prove; or if its concomitant poverty in the ante-tourist era should depress the stature, the racial equilibrium is as good as vanished in two or three generations. It is therefore only where the environment is simple; and especially on the outskirts of the continent, where migration and intermixture are more infrequent, that any constant and normal association of traits may be anticipated. Take a single example from many. We have always been taught to regard the Teutonic peoples—the Goths, Lombards, and Saxons—as tawny-haired, "large-limbed giants." History is filled with observations to that effect from the earliest times. Our maps have already led us to infer as much. Nevertheless, direct observations show that tall stature and blondness are by no means constant companions in the same person. In Scandinavia, Dr. Arbo asserts, I think, that the tallest men are at the same time inclined to blondness. In Italy, on the other edge of the continent, the same combination is certainly prevalent.* Over in Russia, once more on the outskirts of Europe,† the tall men are again found to be lighter complexioned as a rule. Dr. Beddoe asserts that in Britain it is more often true than otherwise.* But if we turn to central Europe we are completely foiled. The association of stature and blondness fails or is reversed in Bavaria, in Baden, along the Adriatic, and in upper Austria and Salzburg, as well as among the European recruits observed in America during our civil war. In Würtemberg alone have we assurance that the relation holds good.† It seems to me significant, however, that when the association fails, as in the highlands of Austria, where the environment is eliminated, as in lower Austria, the tall men again become characteristically more blond than the short ones. In this last case environment is to blame; in others, racial intermixture, or it may be merely chance variation, is the cause.

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* Livi. Anthropometria Militare, pp. 74, 76.

† Globus, vol. xlii, 1892, p. 337.

In order to avoid disappointment, let us bear in mind that in no other part of the world save modern America is such an amalgamation of various peoples to be found as in Europe. History, and archæology long before history, show us a continual picture of tribes appearing and disappearing, crossing and recrossing in their migrations, assimilating, dividing, colonizing, conquering, or being absorbed. It follows from this that, even if our environment were uniform, our pure types must be exceedingly rare. Experience proves that the vast majority of the population of this continent shows evidence of crossing. Thus, in Germany, of six million school children observed on a given day, not one half of them showed the simple combination of dark eyes and dark hair or of light eyes and light hair. In the British Isles it appears that over thirty per cent of persons measured have fair eyes and dark hair—in other words, that the hair and the eyes do not accompany one another in type. Of four hundred and eighty-six students of the Institute of Technology, sixty-five per cent of them were of this mixed type. Even among the Jews, less than forty per cent of them are characterized by the same tinge of hair and eyes; so that in general we can not expect that more than one third of the population will be marked by this simple and single combination. We need not be surprised, therefore, that if we next seek to add a third characteristic, say the shape of the head, to this combination of hair and eyes, we find the proportion of pure types combining all three traits in a fixed measure to be very small indeed. Imagine a fourth trait, stature, or a fifth, nose, to be added, and our proportion of pure type becomes almost infinitesimal. We are thus reduced to the extremity in which my friend Dr. Ammon, of Baden, found himself when I wrote asking for photographs of a pure Alpine type from the Black Forest. He has measured thousands of heads, and yet he answered that he really had not been able to find a perfect specimen in all details, as all his round-headed men were either blond, or tall, or narrow-nosed, or something else that they ought not to be.

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* Stature and Bulk of Man in the British Isles, p. 171. The opposite is perhaps true in Scotland (Topinard, Eléments, p. 491).

† Ranke. Physische Beiträge zur Anthropologie Bayerns, p. 195 *seq.*; and Der Mensch, ii, p. 124. Ammon, in Sammlung gemeinverständlicher, wissenschaftliche Vorträge, Series V, vol. ci, p. 14. Mittheilungen der anthropologischen Gesellschaft in Wien, xxv, p. 70. Zeitschrift für Ethnologie, Supplement, 1884, p. 26. Baxter, *op. cit.*, vol. i, pp. 23, 38. Von Hölder, Zusammenstellung der in Würtemberg vorkommenden Schädelformen, p. 6.

Confronted by this situation, the tyro is here tempted to turn back in despair. There is no justification for it. It is not essential to our position that we should actually be able to isolate any considerable number, nor even a single one, of our perfect racial types in the life. It matters not to us that never more than a small majority of any given population possesses even two physical characteristics in their proper association; that relatively few of these are able to add a third to the combination; and that almost no individuals show a perfect union of all traits under one head, so to speak, while contradictions and mixed types are everywhere present. Such a condition of affairs need not disturb us if we understand ourselves aright. We should indeed be perplexed were it otherwise.

Consider how complex the problem really is! We say the people of Scotland are on the average among the tallest in Europe. True! But that does not mean that a great number of medium and undersized persons do not occur among them. We may illustrate the actual condition best by means of the accompanying diagram.* Three curves are plotted therein for the stature of large groups of men chosen at random from each of three typical parts of Europe. The one at the right is for the tall Scotch, the middle one for the medium-sized northern Italians, and the one at the left for Sardinians, the people of this island being among the shortest in all Europe. The height of each curve at any given point indicates the percentage within each group of men which possessed the stature marked at the base of that vertical line. Thus eight per cent of the Ligurian men were five feet and five inches tall (1·65 metres), while nine per cent of the Sardinians were fully two inches shorter (1·60 metres). In either case these several heights were the most common, although in no instance is the proportion considerable at a given stature. There is, however, for each country or group of men some point about which the physical trait clusters. Thus the largest percentage of a given stature among the Scotch occurs at about five feet nine and a half inches. Yet a very large number of them, about five per cent, fall within the group of five feet seven inches (1·70 metres)—that is to say, no taller

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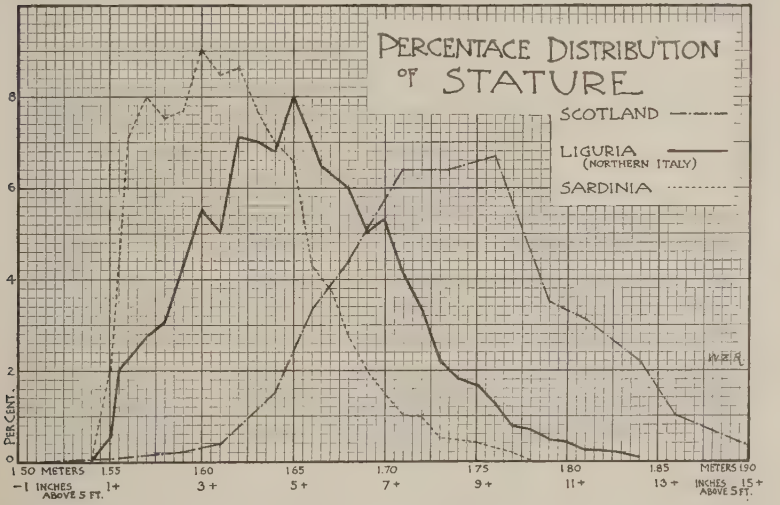
* The curve for the Scotch, taken from the Report of the Anthropometric Committee of the British Association for the Advancement of Science for 1883, has been arbitrarily corrected to correspond to the metric system employed by Dr. Livi in the other curves. A centimetre is roughly equal to 0·4 of an inch. It is assumed that in consequence only 0·4 as many individuals will fall within each centimetre class as in the groups of stature differing by inches. The ordinates in the Scotch diagram have therefore been reduced to 0·4 of their height in the original curve.



than an equal percentage of the Ligurians—and even in Sardinia there is an appreciable number of that stature. We must understand therefore, when we say that the Scotch are a tall people or a long-headed or blond one, that we mean thereby not that all the people are peculiar in this respect even to a slight degree, but merely that in this region there are more specimens of these special types than elsewhere. Still it remains that the great mass of the people are merely neutral. This is a more serious obstacle to overcome than direct contradictions. They merely whet the appetite. Our most difficult problem is to separate the typical wheat from the noncommittal straw; to isolate our racial types from the general mean of the continent.

We have now seen how limited are the racial results attainable by the first of our two means of identification—that is, the purely anthropological one. It has appeared that only in the most simple conditions are the several traits constant and faithful to one another in their association in the same persons. Nor are we justified in asking for more. Our three racial types are not radically distinct seeds which, once planted in the several parts of Europe, have there taken root; and, each preserving its peculiarities intact, have spread from those centers outward until they have suddenly run up against one another along a racial frontier. Such was the old-fashioned view of races in the days before the theory of evolution had remodeled our ways of thinking, when human races were held to be distinct creations of a Divine will. We conceive of it all quite differently. These types for us are all necessarily offshoots from the same trunk. The problem is far more complex to us for this reason. It is doubly dynamic. Upbuilding and demolition are taking place at the same time. By our constitution of racial types we seek to simplify the matter—for a moment to lose sight of all the destructive forces, and from obscure tendencies to derive ideal results. We picture an anthropological goal which might have been attained had the life conditions been less complicated.

Are we in this more presumptuous than other natural scientists? Is the geologist more certain of his deductions in his restoration of an ideal mountain chain from the denuded roots which alone bear witness to the fact to-day? In this case all the superstructure has long since disappeared. The restoration is no less scientific. It represents more clearly than aught else the rise and disappearance, the results and future tendencies of great geological movements. We take no more liberties with our racial types than this geologist with his mountains; nor do we mean more by our restorations. The parallel is instructive. The geologist is well aware that the uplifted folds as he depicts them never existed in completeness at any given time. He knows full well that erosion took place even as lateral pressure raised the contorted strata; that one may even have been the cause of the other. If indeed denudation could have been postponed until all the elevation of the strata had been accomplished, then the restoration of the mountain chain would stand for a real but vanished thing. This, the geologist is well aware, was not thus and so. In precisely the same sense do we conceive of our races. Far be it from us to assume that these three races of ours ever in the history of mankind existed in absolute purity or isolation from one another. As soon might the branch grow separate and apart from the parent oak. No sooner have environmental influences, peculiar habits of life, and artificial selection commenced to generate distinct varieties of men from the common clay; no sooner has heredity set itself to perpetuating these; than chance variation, migration, intermixture, and changing environments, with a host of minor dispersive factors, begin to efface this constructive work. Racial upbuilding and demolition, as we have said, have ever proceeded side by side. Never is the perfect type in view, while yet it is always possible. "Race," says Topinard, "in the present state of things is an abstract conception, a notion of continuity in discontinuity, of unity in diversity. It is the rehabilitation of a real but directly unattainable thing." In this sense alone do we maintain that there are three ideal racial types in Europe to be distinguished from one another. They have often unfortunately dissolved in the common population; each trait has gone its own way; so that at the present time rarely, if indeed ever, do we discover a single individual corresponding to our racial type in every detail. It exists for us nevertheless.

Thus convinced that the facts do not warrant us in expecting too much of our anthropological means of isolating racial types, we have recourse to a second or inferential mode of study. In this we work by geographical areas rather than by personalities. We discover, for example, that the north of Europe constitutes a veritable center of dispersion of long-headedness. Quite independently we discover that the same region contains more blond traits than any other part of Europe; and that a high average stature there prevails. The inference is at once natural that these three characteristics combine to mark the prevalent type of the population. If one journeyed through it, one might at first expect to find the majority of the people to be long-headed and tall blondes; that the tallest individuals would be the most blond, the longest-headed most tall, and so on. This is, as we have already shown, too good and simple to be true, or even to be expected. Racial combinations of traits indeed disappear in a given population, as sugar dissolves, or rather as certain chemical salts are resolved into their constituent elements when immersed in water. From the proportions of each element discovered in the fluid, quite free from association, we are often able to show that they once were united in the same compound. In the same manner, we, finding these traits floating about loose, so to speak, in the same population, proceed to reconstitute types from them. We know that the people approach this type more and more as we near the specific center of its culmination. The traits may refuse to go otherwise than two by two, like the animals in the ark, although they may change partners quite frequently; and they may still manifest distinct affinities one for another nevertheless.

The apparent inference is not always the just one, although it tends to be. Suppose, for example, that one observer should prove that sixty per cent of ten thousand natives of Holland were blondes: and another, studying the same ten thousand individuals, should prove that a like proportion were very tall—would this of necessity mean that the Hollanders were mainly tall blondes? Not at all! It might still be that the two groups of traits merely overlapped at their edges. In other words, the great majority of the blondes might still be constituted from the shorter half of the population. Only twenty per cent need necessarily be tall and blond at once, even in this simple case where both observers studied the same men from different points of view. How much more confusing if each chanced to hit upon an entirely different set of ten thousand men! This, be it noted, is generally the case in practice. Nevertheless, although there is always danger in such inferences, we are fortunate in possessing so many parallel investigations that they check one another, and the tendencies all point in one direction.

These tendencies we may discover by means of curves drawn as we have indicated above in our diagram. By them we may analyze each group in detail. Every turn of the lines has a meaning. Thus, the most noticeable feature of the Sardinian curve of statures is its narrowness and height; the Ligurian one is broader at the base, with sloping sides; and the Scotch one looks as if pressure had been applied at the apex to flatten it out still farther. The interpretation is clear. In Sardinia we have a relatively unmixed population. Nearly all of the people are characterized by statures between five feet one inch (1·56 metres) and five feet five inches (1·65 metres). They are homogeneous, in other words: and they are homogeneous at the lower limit of human variation in stature. The curve is steepest on the left side. This means that the stature has been depressed to a point where neither misery nor chance variation can stunt still further; so that suddenly from seven per cent of the men of a height of five feet one and a half inches [more frequent than any given stature in Scotland] we drop to two per cent at a half inch shorter stature. A moment's consideration will show that the narrower the pyramid, the higher it must be. One hundred per cent of the people must be accounted for somewhere. If they do not scatter sidewise, their aggregation near the center will elevate the apex, or the shoulders of the curve at least. So that a sharp pyramid points to a homogeneous people. If they were all precisely alike, a single vertical line one hundred per cent high would result. On the other hand, a flattened curve indicates the introduction of some disturbing factor, be it an immigrant race, environment or what not. In this case the purity of the Sardinians is readily explicable. They have lived in the greatest isolation, set apart in the Mediterranean. A curve drawn for the Irish shows the same phenomenon. Islands demographically tend in the main to one or the other of the extremes. If unattractive, they offer examples of the purest isolation, as in Corsica and Sardinia. If inviting or on the cross-paths of navigation, like Sicily, their people speedily degenerate into mixed types. For if incentive to immigration be offered, they are approachable alike from all sides. The Scotch, as we have observed, are more or less mixed in type, and unequally subjected to the influences of environment; so that their curve shows evidence of heterogeneity.

Scotland combines the isolation of the highlands with a great extent of seacoast. The result has been that in including the population of both areas in a single curve we find evidence of impurity in the great variability of stature.

By the second geographical method which we have described, we constitute our racial types as the archæologist, from a mass of broken fragments of pottery, restores the designs upon his shattered and incomplete vases. Upon a bit of clay he discovers tracings of a portion of a conventionalized human figure. A full third—let us say the head of Thoth or some other Egyptian deity—is missing. The figure is incomplete to this extent. Near by is found upon another fragment a representation of the head and half the body of another figure. In this case it is the legs alone which lack. This originally formed no part of the same vase with the first bit. It is perhaps of entirely different size and color. Nevertheless, finding that the portions of the design upon the two fragments bear marks of identity in motive or design, data for the complete restoration of the figure of the god are at hand. It matters not that from the fragments in his possession the archæologist can reconstruct no single perfect form. The pieces of clay will in no wise fit together. The designs, notwithstanding, so complement one another that his mind is set at rest. The affinity of the two portions is almost as clearly defined as the disposition of certain chemical elements to combine in fixed proportions; for primitive religion or ornament is not tolerant of variation.

We copy the procedure of the archæologist precisely. In one population color of hair and stature gravitate toward certain definite combinations. Not far away, perhaps in another thousand men drawn from the same locality, the same stature is found to manifest an affinity for certain types of head form. It may require scores of observations to detect the tendency, so slight has it become. In still another thousand men perhaps a third combination is revealed. These all, however, overlap at the edges. Granted that an assumption is necessary. It is allowed to the archæologist. Our conclusions are more certain than his, even as the laws of physical combination are more immutable than those of mental association. For it was merely mental conservatism which kept the primitive designer of the vase from varying his patterns. Here we have unchanging physical facts upon which to rely. Of course, we should be glad to find all our physical traits definitely associated in completeness in the same thousand recruits, were it not denied to us. The archæologist would likewise rejoice at the discovery of a single perfect design upon a single vase. Both of us lack entities; we must be contented with affinities instead.

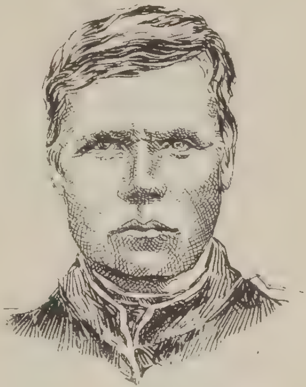
A final step in our constitution of races—that is, of hereditary types—is to prove that they are persistent; that like father like son corresponds to the facts in the case. Of direct testimony we possess nothing. No single investigator, save perhaps Galton, has to my knowledge followed down a line from one generation to another. Anthropologists are human themselves. The life of man is all too short to cover such tasks. But of indirect proof we have plenty. We know, for example, that in the north of Europe, as far back as archæology can carry us, men of a type of head form identical with the living population to-day were in a majority. Likewise the lake dwellers in Switzerland in the stone age, little more civilized than the natives of Africa, were true ancestors of the present Alpine race. Prehistoric archæology thus comes to our aid with cumulative proof that at all events traits are hereditary in populations, even if not always so in men. In truth, we here enter upon a larger field of investigation than the anthropological one. The whole topic of heredity opens up before us, too immense to discuss in this place. Suffice it to say that in the main no question is entertained upon the subject, save in the special cases of artificially acquired characteristics and the like.

After this tedious summary of methods, let us turn to results. The table on this page shows the combinations of traits into racial types which seem best to accord with the facts. It speaks for itself.

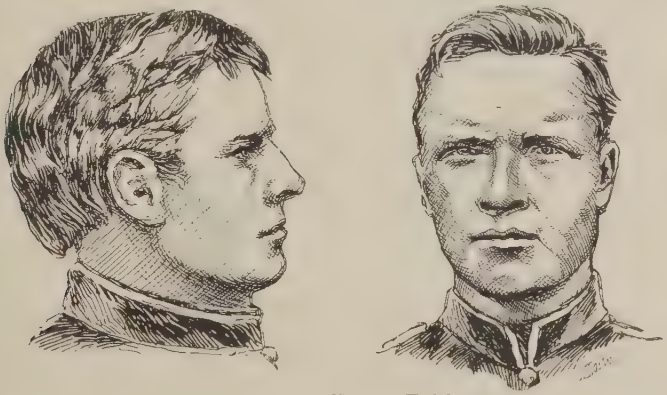
European Racial Types.

		Head.	Face.	Hair.	Eyes.	Stature.	Nose.	Synonyms.	Used by.
1	Teutonic.	Long.	Long.	Very light.	Blue.	Tall.	Narrow; aquiline.	Reihengräber.	Germans.
								Germanic.	
								Kymric.	French.
								Aryan. (?)	
								Homo Europæus.	Lapouge.
2	Alpine (Celtic).	Round.	Broad.	Light chestnut.	Hazel-gray.	Medium.	Variable; rather broad; heavy.	Celto-Slavic.	French.
								Dissentis.	Germans.
								Arvernian.	Beddoe.
								Ligurian.	Taylor.
								Homo Alpinus.	Lapouge.
3	Mediterranean.	Long.	Long	Dark brown or bl'k.	Dark.	Short. (?)	Rather broad.	Iberian.	English.
								Ligurian.	Livi.

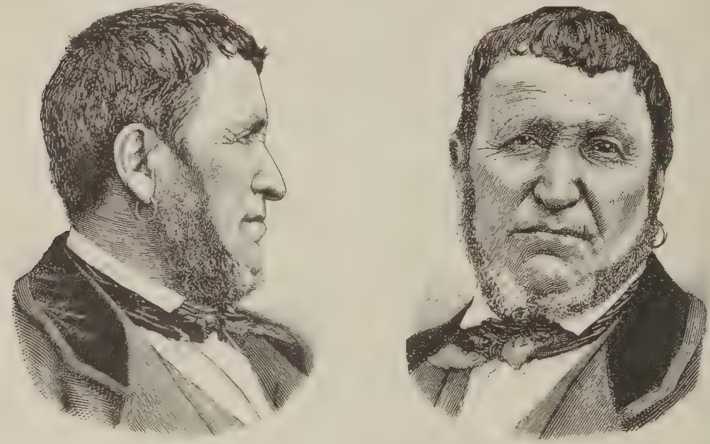
The first of our races is perhaps the most characteristic. It is entirely restricted to northwestern Europe, with a center of dispersion in Scandinavia. Our portraits, chosen as typical by Dr. Arbo of the Norwegian army, show certain of the physical peculiarities, especially the great length of the head, the long oval face, and the straight aquiline nose. The face is rather smooth in outline, the cheek bones not being prominent. The narrow nose seems to be a very constant trait, as much so as the tendency to tall stature. Dr. Collignon has even demonstrated it as a law in France that the relation between the two holds good. The Teutonic race is also strongly inclined to blondness. The eyes are blue or light gray, and the hair flaxen, tawny, reddish, or sandy. The whole combination accords exactly with the descriptions handed down to us by the ancients. Such were the Goths, Ostrogoths, Visigoths, Vandals, Lombards, together with the Danes, Norsemen, Saxons, and their fellows of another place and time. History is thus strictly corroborated by natural science.

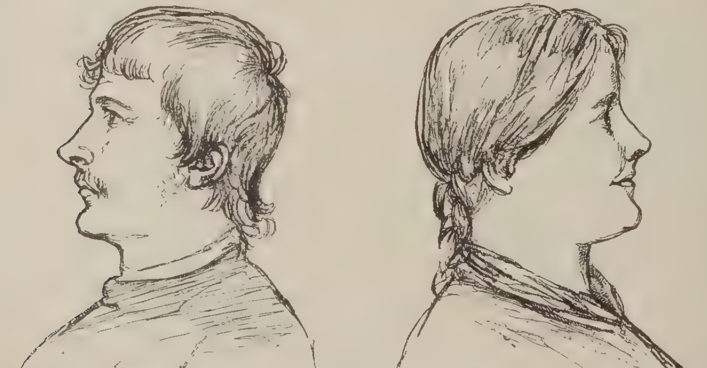

Teutonic Type. Norway, Vaage.
Cephalic Index, 75.

Our second racial type is most persistently characterized by the shape of the head. This is short and at the same time broad. The roundness is accompanied by a broad face, the chin full, and the nose rather heavy. These traits are all shown more or less clearly in our portraits, one from south central France, two from Bavaria, and one from northern Italy. The side views show the shortness of the head as contrasted with the Teutonic type above described. At the same time the cranium is high, the forehead straight, sometimes almost overhanging. It seems as if pressure had been applied front and back, the skull having yielded in an upward direction. This type is of medium height, decidedly inclined toward stockiness in build. Its whole aspect is rather of solidity than of


Teutonic Types. Norway, Hedalen.
Cephalic Index, 76.

agility. The color of the hair and eyes is rather neutral, at all events intermediate between the Teutonic and Mediterranean races. There is a tendency toward grayish eyes, while the hair is more often brown. In these respects, however, there is great variability, and the transition to the north and south is very gradual. Climate or other environmental influence has in these traits eliminated all sharp division lines. These peculiarities appear only when the type is found in extreme isolation and purity.


Alpine Type. Auvergne, Central France.

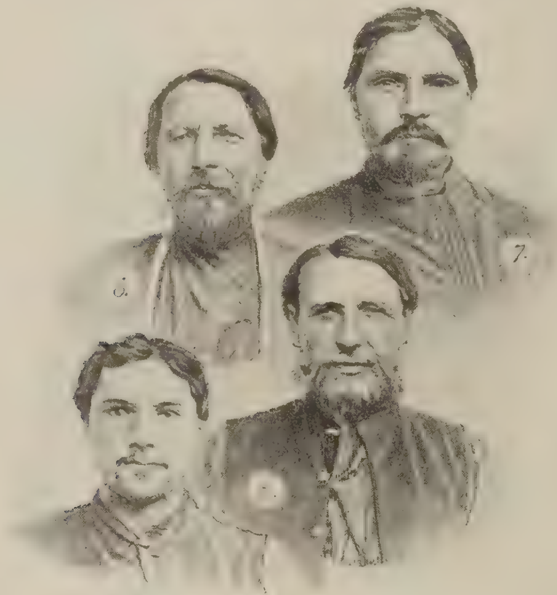

Alpine Types. Bavaria.

What name shall we apply to this second race, characterized by its great breadth of head primarily, and which has its main center of dissemination in the Alps. For the first three of our types the task of christening was simple enough. To name this second one would have been comparatively easy as well, if Cæsar had not introduced his Commentaries by the well-known passage: "All Gaul is divided into three parts, one of which the Belgæ inhabit; the Aquitani, another; those who in their own language are called Celts, in ours Gauls, the third." The so-called *Celtic question* is all involved in this simple statement. Let us reduce it to its lowest terms. The philologers properly insist upon calling all those who speak the Celtic language Celts. With less reason the archæologists follow them and insist upon assigning the name Celt to all those who possessed the Celtic culture; while the physical anthropologists, finding the Celtic language spoken by peoples of divers physical types, with equal propriety hold that the term Celt should be applied to that physical group or type of men which includes the greatest number of those who use the Celtic language. This manifestly operated to the exclusion of those who spoke Celtic but who differed from the linguistic majority in physical characteristics. The practical result of all this was that anthropologists called the tall and blond people of northern France and Belgium, Gauls or Kymri; and the broad heads of middle and southwestern France Celts: while Cæsar, as we saw, insisted that the Celt and the Gaul were identical. The anthropologists affirmed that the Celtic language had slipped off the tongues of some, and that others had adopted it at second hand. Their explanation held that the blond Belgæ had come into France from the north, bringing the Celtic speech, which those already there speedily adopted; but that they remained as distinct in blood as before. These anthropologists, therefore, insisted that the Belgæ deserved a distinctive name: and they called them Gauls, since they ruled in Gaul, in distinction from the Celts, who, being the earlier inhabitants, constituted the majority of the Celtic-speaking people. This was a cross-division with the philologists, who called the Belgæ Celts, because they brought the language, reserving the name Gaul, as they said, for the natives of that country; but

Alpine Type. Piedmont, Northern Italy. Cephalic Index, 91·2.

both philologists and anthropologists alike differed from the historians, who held to Cæsar's view that the Gauls and the Celts were all one.

Still greater confusion arises if we attempt to discuss the origin of the people of the British Isles, where this Celtic question enters again. Thus the people of Ireland and Wales, of Cornwall and the Scottish Highlands, together with the Bretons in France, would all be Celtic for the linguist because they all spoke the Celtic language. For the anthropologist, as we shall see, the Breton is as far from the Welsh as in some respects the Welsh are from the Scotch.



Alpine (Slavic) Types. Middle Russia.

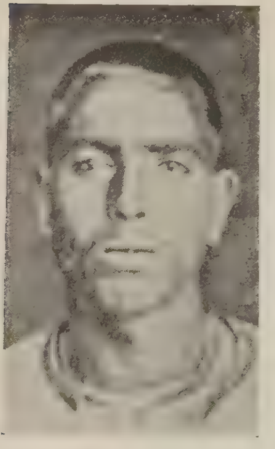
It happened that the father of modern anthropology, the illustrious Paul Broca, having pre-empted the term Celt for the people including most of the broad-headed type and its main crosses, all the anthropologists have followed him. The linguists have refused to yield their side, and still use the name in their own sense. We shall not seek to solve the question. If we have shown what confusion may result from the use of this term, we are content. Our own view is that the linguists and the archæologists are perhaps better entitled to the name *Celt*; but that they should be utterly denied the use of the word *race*. Be this as it may, we shall invent a new term, or rather adopt one from M. de Lapouge, and call the broad-headed type Alpine. It centers in that region. It everywhere follows the elevated portions of western Europe. It is, therefore, pre-eminently a mountain type, whether in France, Spain, Italy, Germany, or Albania. By the use of it we shall carefully distinguish between language, culture, and physical type. Thus the Celtic language and the Aryan culture may spread over the Alpine race, or *vice versa*. As, in fact, each may migrate in independence of the others; so in our terminology we may distinctly follow them apart from one another. No confusion of terms can result. It is purely a geographical name, like the one we have applied to the third group.

Mixed Alpine (Asiatic) Type.
Hungary.

One more matter of racial names remains for consideration. What shall we do with the term *Slavic*, which like Celtic is purely a linguistic or ethnological term? Curiously enough, from Poland to Macedonia, all over eastern Europe in fact, where the Slavic language is in common use, the people are of the same physical type as the Alpine race. The distinctive features, especially the broad-headedness, are somewhat attenuated, to be sure; but anthropologists are agreed that the two groups are identical. Our Russian portraits show the tendency in this direction. In eastern Europe, however, this type ceases to be identified with the mountainous areas. Its zone of extension is widespread over the plains. Shall we continue to call these people Slavs from their language, or assign them to the Alpine group despite this circumstance? Or shall we, as in recent vogue, apply the term Slavo-Celtic to the whole combination? The question is still further confused because the Slavic language linguistically is akin to the Teutonic, although the two physical types are as wide apart as the poles. If we reject our term Celt,

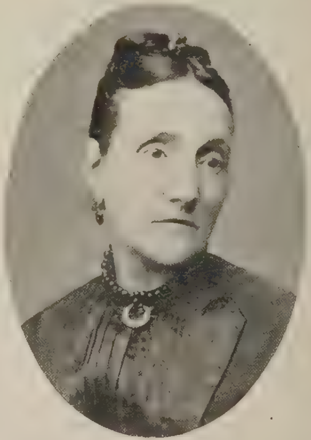
Mediterranean Type. Corsican.
Cephalic Index, 72·3.

the other, being equally a linguistic term, should go as well. The only alternative seems to be to apply the term *Homo Alpinus* to this broad-headed group wherever it occurs, whether in mountains or plains, in the west or in the east. The name is justified by the circumstance that its main body occurs in the Alps, and that its purest types culminate there as well.



Berber, Tunis.
Cephalic Index, 72.

We now come to the last of our three races, which is generally known as the Mediterranean or Iberian type. It prevails everywhere south of the Pyrenees, along the southern coast of France, and in southern Italy, including Sicily and Sardinia. Once more we return to a type of head form almost identical with the Teutonic. Our portraits of Corsicans on a preceding page, with the enlargement of one of the four in the group, show the exaggerated length of face and the narrowness of the forehead. The cephalic index drops from eighty-seven and above in the Alps to about seventy-five all along the line. This is the primary fact to be noted. Coincidently, the color of hair and eyes becomes very dark, almost black. The figure is less amply proportioned, the people become light and rather agile. It is certain that the stature at the same time falls to an exceedingly low level: fully nine inches—more than a head—below the averages for Teutonic Europe. Authorities are, however, divided as to the significance of this. It has been shown that while the average height is low, a considerable number, and those of the purest type in other respects, are of goodly stature. It may indeed be that, as we have already suggested, too protracted civilization is responsible for this diminutiveness. The people of northern Africa (illustrated by our portrait), pure Mediterranean Europeans, are of medium size in fact. Personally I incline to the view that culture is to blame, and that the type is normally of



Mediterranean Type. Montpellier.
Cephalic Index, 67.

medium size, although it would be impossible of proof at this writing.

It would be interesting at this time to follow out the intellectual differences between these three races which we have described. The future social complexion of Europe is largely dependent upon them. The problem is too complicated to treat briefly. In a later paper, devoted expressly to modern social problems, we may return to it again. Our physical analysis is now complete. The next task is to trace the origin of nationalities from the combination of these elements. We shall begin with the French; for this single nation is, alone in all Europe, compounded of all three racial elements; nay, more, we shall be able to point to a still older population than any of these, living to-day in France, with an unbroken ancestry reaching back to the prehistoric stone age.

GLOBE LIGHTNING.

By M. HAGENAU.

OCCASIONALLY in thunderstorms peculiar electrical apparitions occur, similar in destructiveness to ordinary lightning, but by no means so transient. Their duration is measured, not by thousandths of a second, but by whole seconds or even minutes. They move so slowly that their progress can be accurately followed by the eye. As they generally appear in the form of glowing spheres, they are known as fireballs or globe lightning. The first account of this peculiar form of lightning was given by the celebrated English physicist, Robert Boyle, who described a ball which suddenly appeared on July 24, 1681, on the ship Albemarle. The sailors attacked it in vain with blows and water, but it burned itself out, leaving behind a strong smell of gunpowder.

In Boyle's time ordinary lightning flashes were thought to consist of inflamed gas, so that an occurrence like the above did not appear particularly striking, but later investigators were unable to make the fireball fit their knowledge and theory of electricity, and declared it to be a myth. A layman stated that such a ball appeared in his room during a storm and slowly made its way to the chimney. The scientific people asserted that it was an illusion of the senses, and that there were no such things as fireballs. But the balls continued to appear, in some instances being simultaneously seen by a number of trustworthy witnesses, so that their existence had to be admitted.

Let us notice a few well-attested recent cases:

Dr. A. Wartmann has given the Physical Society of Geneva an account of a ball which he observed during a very violent storm on December 20, 1888, at half past six in the evening, while he was driving from Versoix to Genthod. As he passed the entrance gate of a large mansion he became aware of a very bright and persistent illumination, quite different from the intermittent light of the incessant lightning flashes.

Thinking it was a fire, he turned and saw, about one thousand feet away, a ball of fire some eighteen inches in diameter. It floated about half its diameter above the ground, and moved parallel with his own course with the swiftness of a hawk, leaving no trace behind it.

At a point about twenty-five yards ahead of him it burst with an appalling crash. "It seemed to me," the report concludes, "to throw out lines of fire. We felt a violent shock, and were blinded for several seconds. As soon as I could distinguish anything, I saw that the horses were standing at right angles to the carriage, with their heads toward the hedge. Their ears drooped, and they exhibited every symptom of intense fright." At the same time, a little less than a mile away, a farmer found himself surrounded by a violet light. He heard a loud explosion, and was thrown bodily ten feet, alighting on a piece of soft turf, more frightened than hurt.

On July 1, 1891, a fireball entered a carpenter's cabin near Schlieben. The carpenter was sitting on the edge of a bed on which a child was sleeping. A ball of fire sprang suddenly and with a loud noise from the fireplace to the bed, which was immediately shattered. Then the ball rolled very slowly to the opposite wall of the room, through which, or the floor, it apparently vanished with another fearful crash without setting fire to anything. The man's wife and another child were sleeping in a second bed and the baby in a cradle, all in the same room, but none of the five persons was wounded or even stunned. All complained of headache and deafness on account of the heavy sulphurous vapor which filled the room, but they soon recovered. Some fractures were discovered about the stove and chimney.

Less fortunate were the children in a schoolhouse in Bouin, France, who were visited by a fireball while at their afternoon prayers. It was preceded by a shower of lime, wood, and stones. The ball, which was small, rolled along under the benches, killing three of the children, and went out through a window pane, in which it merely made a round hole, whereas all the other panes were shattered.

On January 2, 1890, a ball appeared in an electro-technical establishment in Pontevedra, Spain. It was seen to strike the line wires about nine o'clock in the evening *under a clear sky*, but no one could say just how it struck or from what direction it came.

The ball, which was about as big as an orange, moved slowly along the wires to the central station and struck the dynamo, which was running. Before the eyes of the terrified workmen it sprang twice from the dynamo to the wires and back. Then it fell from the machine and burst into a shower of sparks without doing any damage. The electric lamps flickered during its visit, and the thick copper plates of the switch were melted and welded in places.

Of especial interest is the appearance of a large number of balls during a tornado on August 18, 1890, in the French *Departement Ille et Vilaine.* A farmer of Vizy, who was caught by the storm in the field, saw a fireball fall with great velocity. Panic-stricken, he threw himself on the ground. The luminous ball struck the earth, burst with a loud noise, and covered him with dust.

Dwellers in Vers l'Eau and Samiset saw balls as large as a man's head and of a vivid red, which moved slowly toward some barns, where they vanished after setting the haystacks on fire. In Saint-Claude a great number of balls entered dwellings by the chimneys. They moved slowly to and fro and escaped through windows, doors, and walls, after doing more or less damage. The air in the houses was impregnated with the smell of sulphur or gunpowder.

The region of the Hochgebirge is especially favorable for the observation of globe lightning.

Alluard, the director of the observatory on the Puy-de-Dôme, reports that frequently during thunderstorms showers of small balls of fire are seen falling. On the peak Saentis, in the same region, where a meteorological station was founded at an elevation of twenty-five hundred and four metres in 1882, some very remarkable phenomena were observed by a minister named Studer on June 28, 1885. He and a companion were caught out in the storm after nightfall. All at once they saw on the ridge extending from Saentis to the neighboring peak of Altmann flaring flames and small yellow balls of light. The latter ran along as if on a wire, approached each other, then exploded and fell down. A single larger ball of fire hovered over the same ridge, moving to and fro in a flat parabola with about the speed of a ball thrown by the hand, except that its velocity was uniform. It was visible for several minutes. Then there was a frightful explosion, which seemed to shake the whole mountain to its foundations, and a display of natural fireworks, "of a magnificence never before witnessed," amazed the spectators.

The telephone wire from the station to the valley glowed with great brilliancy as far as it could be seen, and waving sheets of fire extended from it to the ground. Suddenly the whole fiery mass fell to the earth, the wire melted, and the spectators were left in total darkness.

The nature of this peculiar form of lightning is not yet understood, although Planté and F. von Lepel have succeeded in producing in the laboratory, with the aid of powerful electrical machines, small balls of fire which, like those of Nature, moved to and fro for a while and then vanished.

These experiments have suggested the theory that the fireballs consist of heated air and water vapor. But this theory is insufficient, and gives no satisfactory explanation of the various phenomena which have been observed. The subject still needs investigation. It is especially desirable to increase our store of working material—that is, of observations. Whoever, therefore, is fortunate enough to have witnessed a display of globe lightning should communicate his observations to one of the meteorological journals.—*Translated for the Popular Science Monthly from Die Gartenlaube, by Lawrence B. Fletcher.*

WORLD'S GEOLOGISTS AT ST. PETERSBURG.

By WILLIAM H. BALLOU.

THE Fifth International Geological Congress at Washington received an invitation from the Russian government to hold its seventh session in St. Petersburg. The Sixth Congress at Zürich accepted the invitation. By unanimous vote, A. Karpinsky, Director of the Committee of Geologists of Russia, was elected president of the Bureau of Organization; A. Inostranzew, vice-president; Th. Tschernyschew and N. Androussow, secretaries.

His Majesty the Czar will open the Seventh International Congress at St. Petersburg on August 17th, and welcome the visiting delegates to his empire. The Grand Duke Constantinovitch will act as Honorary President. Prof. Karpinsky will doubtless be made President of the congress. Circulars of information in French have been received by geologists, outlining the occupations of the delegates, so far as the Russians can arrange for their pleasure. The sessions will last seven days, preceded and succeeded by intervals of geological and sight-seeing excursions, covering the principal areas of Russia.

In many respects this will be the most important of the congresses so far held. The geological map of Europe, which will probably be printed complete in two years, will be exhibited. Segments of this map have already been received by geologists, and will probably have their hearty approval at the congress. The committee on geological nomenclature will doubtless make a fair showing, although beset by many difficulties in harmonizing the views of members. A difference of opinion of grave proportions, which has threatened the life of past congresses, concerns the probable culmination of previous attempts of geologists to get the control of the organization out of the hands of officials of the scientific bureaus of various governments. The excursions laid out certainly cover a vast territory, including the Ural Mountains, Moscow, Volga River region, Samara to Kazan, the glacial formations of Esthonia, Finland, basin of the Donetz, mineral waters of Vladikavkaz, Nijni-Novgorod, Kiew, Dnieper River, to Tiflis and glaciers by military route of Georgia, Tiflis to Baku, Batoum, and Kertch, all parts of the Crimea, Sebastopol, southern Russian mining region, to the glacier Guenaldon at Piatigorsk, Lake Gokhtcha, Mount Ararat, etc.

The Grand Duke Constantinovitch, President of the Imperial Academy of Sciences and Honorary President of the Congress.

The International Geological Congress was conceived by the American Association for the Advancement of Science at the Buffalo meeting, 1876, when a resolution was adopted, calling for such a congress to be held in Paris in 1878. The committee comprised W. B. Rogers, Dr. James Hall, J. W. Dawson, the late Dr. J. S. Newberry, the late Dr. T. Sterry Hunt, C. H. Hitchcock, R. Pumpelly, of America; the late Prof. T. H. Huxley, Dr. Otto Torrell, and E. H. van Baumhaur, of Europe. Dr. Hall was made chairman of the committee and Dr. Hunt secretary. Their labors resulted in the first international congress being held in Paris in 1888. The second congress was held in Bologna, the third in Berlin, the fourth in London, the fifth in Washington, and the sixth in Zürich, at intervals of three years.

The geological map of Europe was conceived at the congress of Bologna, where it was determined that the methods of accomplishing the ends of unification in nomenclature and coloring had become sufficiently understood. It was thought best to select

Prof. A. Karpinsky, Director of the Imperial Geological Survey and President of the Bureau of Organization of the Congress.

Europe as the subject of the map because it contained a great area, practically well known, the largest number of geologists, and included the greatest number of cartographical difficulties. Containing the largest number of geologists, representing many nationalities, it was conceded that any map which could pass their acceptance would stand any test of criticism elsewhere. The inherent puzzles of structure in Europe furnished a fascinating series of difficult problems for solution, long and zealously discussed, with both natural and artificial intricacies. No better area to test the patience and tax the genius of the congress could have been chosen. The committee appointed to prepare the map comprised Messrs. Beyrich and Hauchecorne, of Germany, with power of direction at Berlin; Prof. Renevier, of Switzerland, as general secretary; Messrs. Daubrée, of France; Giordano, of Italy; A. Karpinsky, of Russia; Mojsisovics, of Austria-Hungary; and Topley, of Great Britain. Professors Daubrée, Giordano, and Topley have since died. The scale of the map is one in one million and a half. It is divided into forty-nine sheets of 18·89 by 20·86 inches. These sheets, when all are completed, will form a rectangle 11·04 feet high by 12·17 feet wide. The topographic base was prepared by Prof. Kiepert, of Berlin. D. Reimer & Co., Berlin, are the pub-

Dr. James Hall, New York State Geologist.

lishers at their own risk. The price of the work was fixed at 125 francs ($25). The various national committees subscribed and paid the publishers for nine hundred copies at the rate of 100 francs each. The map represents the completest and most accurate geological information obtainable, and every step in its progress has been carefully taken, so that the result forms a consensus of European opinion.

Prof. Persifor Frazer, Philadelphia Academy of Sciences.

At the last congress at Zürich, Switzerland, two propositions were submitted by Dr. Persifor Frazer, and the bureau was ordered to report on them at St. Petersburg, as follows:

"1. To what extent does the congress recognize the right of governmental bureaus as such, or of any kind of organizations, to send representatives to the congress?

"2. Within what limitations does the congress recognize the right of such representatives, or of only a portion of the members of the congress coming from the same country, to choose who shall be the vice-president representing their country, or to take any other steps in the name of their country without consultation of all of their countrymen, members of the congress?"

In these propositions is said to lie the future of international geological congresses. If government officials are alone to represent

The Late Prof. E. D. Cope, University of Pennsylvania.

PROF. C. D. WALCOTT, Director, United States Geological Survey.

countries and hold office, the congress at St. Petersburg may be the last. Formerly the officers of geological surveys of nations fought the establishment of the congress. The congresses once established, the bureaucrats changed front, got hold of the machinery through their representatives, and now mostly control it. At St. Petersburg the unofficial geologists of the world will try to wrest the direction from the members of geological surveys. At Zürich, for instance, there were present thirteen of the most distinguished geologists of the United States. Two salaried assistants of the United States Geological Survey were declared by the Swiss council alone eligible and representative, and were made vice-president and delegate from the United States. At present too many members of government bureaus comprise the official roster of the congress, although the congress itself is composed of several hundred of the most distinguished geologists of the world, who, if not members of a geological survey, are ignored by those now in control. This is a situation which does not commend itself to scientific men, many of whom occupy chairs in great universities or eminent positions as specialists. These men think the abuse has become a flagrant one.

PROF. J. J. STEVENSON, University of New York, President New York Academy of Sciences.

PROF. C. H. HITCHCOCK, Dartmouth College.

If there is an object for the congress to accomplish, it is to open its doors and honors equally to all geologists. It is thought that if the congress decides that only bureau employees enjoy exclusive privileges and alone constitute the *personnel* of the permanent organization, which keeps the organization alive in session and out, then the body has simply become a medium of officialism, a governments' trust, and should be disbanded. As a trust, it will simply continue to extenuate errors and preserve the power of government survey directors. The independent geologists think the congress has been perverted and diverted from its original high purpose, and that the time has come to rescue it. They desire it to be the highest tribunal of appeal on purely scientific matters.

PROF. B. K. EMERSON, Amherst College.

The protesting Americans are led by Dr. Persifor Frazer, of Philadelphia, who is an able linguist and parliamentarian. He will represent the American Philosophical Society, the Philadelphia Academy of Sciences, and the editorial staff of the American Geologist. Prof. Giovanni Capellini (Italy), who recently received the Hayden medal and who will probably be decorated by the Czar at this congress, thinks the battle against officialism already won. In a recent letter he states: "The committee of organization has the good

Prof. William N. Rice, Wesleyan University.

intention of returning the congress to the right path, in conformity with the object of its institution, having recognized that it has been entirely deflected from its path in Switzerland." While the committee's "intentions" may be good, it will require something more powerful to break down officialism and restore the chair of a university to its equality with a membership of a government bureau.

Two international committees have been at work for some years to secure a uniform nomenclature and coloration in European geological science. At each session of the congress the intervening work of these committees has been adopted, clause by clause. Whenever unsettled questions were announced they were either adjourned to subsequent sessions, or discretion was granted to the committees to mature their own plans. The committees have been remarkably successful, and no attempt has been made by them to force their conclusions on the congresses or introduce into the discussions the narrow partisanship of particular schools. Among the men who have been active in the unification of coloration are Profs. Zittel and Hauchecorne, of Germany; Prof. Thomas McKenny Hughes, of England; Prof. Del-

Prof. N. H. Winchell, University of Minnesota, State Geologist.

walque, of Belgium; Prof. de Lapparent, of France; Prof. J. Szabó, of Hungary; Profs. Delgado, Choffat, Bensaude, Goncalves, and de Lima, of Portugal; Prof. Stefanescu, of Roumania; Prof. Mayer-Eymar, of Switzerland; Profs. Capellini and de Zigno, of Italy; Prof. Nikitin, of Russia; Prof. Stur, of Austria; Prof. Vilanova, of Spain; Prof. Johnstrup, of Denmark; Prof. Kjerulf, of Norway; Prof. van Calker, of Holland; and Prof. Torrell, of Sweden.

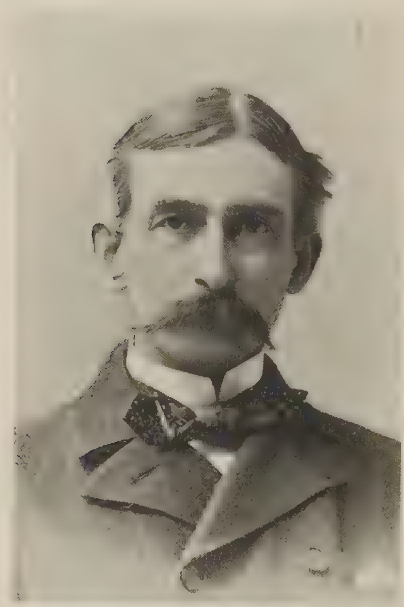
The committee on the unification of the nomenclature of rocks comprises Knop, Zirkel, and Rosenbusch, of Germany; Golliez, Hutenmal, and Schmidt, of Switzerland; Renard and de la Vallée Poussin, of Belgium; Behrens and Wichmann, of Holland; Macpherson and Gonzalo y Farin, of Spain; Bensaude, of Portugal; Michel-Levy, Barrois, and La Croix, of France; Teall, Geikie, and Judd, of England; Brögger, of Norway; Zujovis, of Roumania; Löwinson-Lessing, of Russia; Tietze and Tschermak, of Austria-Hungary; J. P. Iddings, Whitman Cross, and C. R. Van Hise, of the United States; and Barcena, of Mexico.

A committee will report on an exhaustive study of the changes which occur in glaciers, for which Prince Roland Bonaparte is chairman and pays the cost. It is composed as follows: Richter, of Austria; Fintswalder, of Germany; Reid, of the United States; Bonaparte, of France; Hall, of England; and Forel, of Switzerland.

Prof. Eugene A. Smith, University of Alabama, State Geologist.

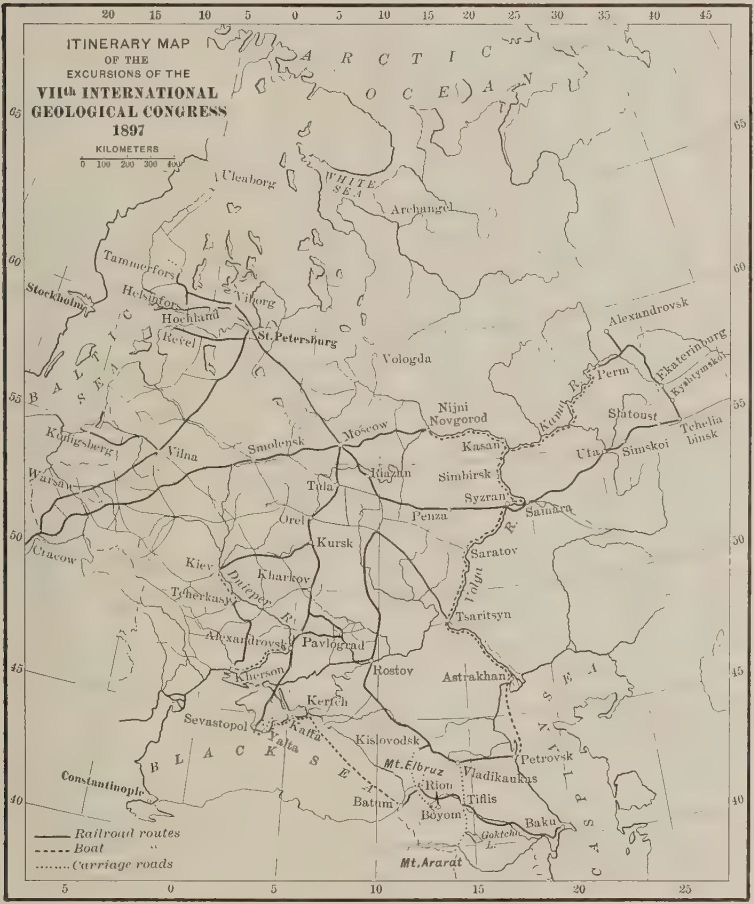
The original American committee of the International Congresses has been somewhat decimated by death. It comprised Prof. James Hall, chairman, Albany; Dr. Persifor Frazer, secretary, Philadelphia; the late Dr. J. S. Newberry, New York; the late Dr. T. Sterry Hunt, Montreal; Prof. C. H. Hitchcock, Hanover, N. H.; Prof. Raphael Pumpelly, Newport; Prof. H. S. Williams, Yale; Prof. J. P. Lesley, Philadelphia; Major J. W. Powell, Washington; the late Prof. G. H. Cook, Brunswick, N. J.;

Prof. J. J. Stevenson, New York; the late Prof. E. D. Cope, Philadelphia; Prof. Eugene A. Smith, Tuscaloosa, Ala.; Prof. N. H. Winchell, Minneapolis; and the late Prof. James D. Dana, New Haven. Most of those above living will be present at St. Petersburg, and are nearly all opposed to the control of the congress by bureaucrats. Through the efforts of the former *personnel* of the United States Geological Survey, the American committee was abolished at the Indianapolis meeting of the American Association for the Advancement of Science, where the survey staff got temporary control. At the last meeting of the Association, at Buffalo, the following delegates were appointed to St. Petersburg: Prof. James Hall, Albany; the late Prof. E. D. Cope, Philadelphia; Prof. B. K. Emerson, Amherst; Prof. C. D. Walcott, Washington; and Prof. W. N. Rice, Middletown. These delegates will soon be made a new American committee, and their number materially increased in the near future. The delegates of the Geological Society of America will comprise Prof. J. J. Stevenson, New York University; Prof. B. K. Emerson, Amherst College; and Prof. I. C. White, Morgantown, W. Va.


Prof. H. S. Williams, Yale College.

All objects for exhibition bearing the address "Russia, St. Petersburg Exposition of the International Geological Congress," can go through without having to be submitted to customs inspection at the frontier. Russian consuls everywhere have been instructed to *visé* passports of geologists presenting membership cards, which will also facilitate matters at the frontier. Members will receive a ticket of first-class transportation on all Russian and Finland railways. The sessions of the congress will be held at the Imperial Academy of Sciences.

Accompanying this article is a copy of the official map of the excursions offered to geologists by the Russian Government, which has made great sacrifices to entertain its guests. Over six hundred membership cards have been issued, in consequence of which the committee has decided to exclude from the excursions all who are not authors of geological publications. It is estimated that the restriction will reduce the number of excursionists to about two hundred people. The cost of the excursions, reduced to the mere maintenance of individuals, has been fixed



approximately as follows: To the Urals, four hundred francs; in Esthonia, one hundred and thirty-five francs; to Finland, fifty francs; the great excursion after the congress, six hundred and sixty-five francs; to Ararat, two hundred and seventy francs; to the glacier Mamisson, one hundred and twenty francs; to Elborous or Sebastopol, forty francs additional to general excursion. Each of the smaller and special excursions have a price established, estimated at twenty-one francs per day. The committee will refund any overcharges made. These magnanimous reductions in the cost of travel are due to the personal efforts of A. Yermolow, Minister of Agriculture, to the proprietors and administrations of the districts having works, and to the officers of municipalities along the routes of the excursions.

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WOMAN SUFFRAGE AND EDUCATION.*

By HELEN KENDRICK JOHNSON.

IN 1848 a Woman-Suffrage Convention, called by Mrs. Stanton, Mrs. Mott, and others, issued a "Declaration of Sentiments," which was an imitation of the famous Declaration of Independence. It constituted an elaborate indictment of man as the oppressor of woman, and the suffrage leaders of to-day still hold to it as their broad exposition of principles. The seventh count in the indictment was, "He has denied her facilities for obtaining a thorough education, all colleges being closed against her."

Among the resolutions passed in an early suffrage convention was one demanding "equal rights in the universities," and the first petition presented by suffrage advocates contained a clause asking that entrance to men's colleges be obtained for women by legal enactment. We note that this is far from being a demand for education for women equal to that given to men in the universities. Men have founded colleges for women, men and women have worked together in securing for woman every facility and opportunity for education of the highest grade; but the "barrier of sex" is not broken down in education. But few of the older colleges for men admit women, and those few, so far as I have learned from conversation with members of their faculties, speak of the arrangement as an experiment, and give the need for economy, combined with a desire to assist women, as a reason for making that experiment. Meantime the knocking at men's literary portals by suffrage advocates has gone on as vigorously as if women could obtain education in no other way.

In the first suffrage convention ever held in Massachusetts these two resolutions were adopted: "That political rights acknowledge no sex, and therefore the word 'male' should be stricken from every State Constitution"; and "that every effort to educate woman, until you accord to her her rights, and arouse her conscience by the weight of her responsibilities, is futile, and a waste of labor."

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* From Woman and the Republic. By Helen Kendrick Johnson. In press of D. Appleton & Co.

The State in which these sentiments were uttered abounded in fine schools for girls, among which were Mount Holyoke and Wheaton Seminaries.

A rapid survey of some of the educational conditions that led to the state of things existing when suffrage associations were formed will be in place. Learning seemed incompatible with worship early in the Christian era. The faith that worked by love was "to the Jews a stumbling-block and to the Greeks foolishness." That great battle between the felt and the comprehended, which in this era we have named the conflict between science and religion, was decided in the mind of the apostle to the Gentiles when he wrote: "We know in part, and we prophesy in part; when that which is perfect is come, that which is in part shall be done away." He recalled the accusation, "Thou art beside thyself, much learning hath made thee mad," and he hastened to assure the unlettered fishermen and the simple and devout women who were followers of Christ, that "all knowledge" was naught if they had not love; that even faith was vain if it led to the rejection of the diviner wisdom that a little child could understand.

The great learning of Augustine and the Fathers brought into the Church pagan speculations of God and morality, as well as pagan knowledge in art, science, and literature. The Church became corrupted, and a great outcry was made against the learning itself, which was falsely supposed to be the cause of the degeneration of faith. Symonds says that during the dark ages that followed upon this first battle between faith and sight, the meaning of Latin words derived from the Greek was lost; that Homer and Virgil were believed to be contemporaries, and "Orestes Tragedia" was supposed to be the name of an author. Milman says that "at the Council of Florence in 1438, the Pope of Rome and the Patriarch of Constantinople being ignorant, the one of Greek and the other of Latin, discoursed through an interpreter." It was near the time of the Reformation that a German monk announced in his convent that "a new language, called Greek, had been invented, and a book had been written in it called the New Testament." "Beware of it," he added, "it is full of daggers and poison."

But the tradition of the love that book revealed had crept into the heart of the world, and now awoke. Through what struggles the "spirit of all truth" promised by Christ was leading, and would lead the world, the history of civilization can tell. Women shared in some degree the outward benefits of the revival of learning. They became in not a few instances doctors of law and professors of the great universities that sprang up, as well as teachers, transcribers, and illuminators in the great nunneries.

I could give a long and honorable list of names of woman writers and artists, in many lands, from mediæval to modern times; and one of the interesting things revealed by such a record would be the number who were working with or were directly inspired and helped by a father or a brother. The court had some names of women who, like Lady Jane Grey, upheld the model of purity while taking the learning that naturally accompanied wealth. But elegant letters had again become the associate of moral and religious corruption in the courts, and the "ignorance of preaching" arose to combat it in Cromwell, the Roundheads, the Dissenters, the Covenanters.

Yet sound learning was not to die that Christian truth might live. Of the band of Pilgrims and Puritans that came first to our shores, about one in thirty was college bred. While subordinating book knowledge to piety, they had learned scarcely less the dangers of ignorance. Their first college was founded because of "the dread of having an illiterate ministry to the churches when our ministers shall lie in dust." Charles Francis Adams says, in regard to the establishment of Harvard College, "The records of Harvard University show that, of all the presiding officers during the century and a half of colonial days, but two were laymen, and not ministers of the prevailing denomination." He further says that "of all who in early times availed themselves of such advantages as this institution could offer, nearly half the number did so for the sake of devoting themselves to the gospel. The prevailing notion of the purpose of education was attended with one remarkable consequence—the cultivation of the female mind was regarded with utter indifference."

It was attended with still another remarkable consequence, the effect of which is felt up to this hour. Only men who were fitted for a profession were given a college education. It is well within my memory when it began to be seriously said: "A college education is good for a boy, whether he intends to follow a profession or not; it will make him a better business man, or even a better farmer." The country girl is now, as a rule, better educated than her brother. It also happened in those earlier days that the artist and the musician were expected to attain knowledge by intuition, save in technical branches.

During the first two hundred years of our existence it would have been almost absurd to expect that women would be extensively educated outside the home. The country was poor, and struggling with new conditions, and great financial crises swept over it. There were wars and rumors of wars. Until after 1812–'15 American independence was not an assured fact. Whatever may be said of the present, woman's place in America then was in the home, and nobly did she fill that place. That she had not been wholly uninstructed in even elegant learning is evidenced by the share she took in literature and in the discussion of religious and public matters, and in such personal records as that of Elder Faunce, who eulogized Alice Southworth Bradford for "her exertions in promoting the literary improvement and the deportment of the rising generation." Dame schools were early established for girls, and here were often found the sons of the farmer and the mechanic. These were established in Massachusetts in 1635. Late in 1700 girls were admitted through the summer to "Latin schools" where boys were taught in winter, and in 1789 women began to be associated with men as teachers. In 1771 Connecticut founded a system of free schools in which boys and girls were taught. In 1794 the Moravians founded a school for girls at Bethlehem, Pennsylvania. Here were educated the sisters of Peter Cooper, the mother of President Arthur, and many women who became exponents of culture.

New England began before this to have fine private schools for girls, but no great step was taken until Miss Hart (afterward Mrs. Willard) had become so successful with her academy teaching in her native town of Berlin, Connecticut, and in Hartford, that three States simultaneously invited her to establish schools within their borders. She went to Massachusetts, but afterward, at the solicitation of Governor Clinton, of New York, she removed her school to Troy in 1821. It was a new departure, and there was ignorant prejudice to overcome. Governor Clinton, in an appeal to the Legislature for aid, said, "I trust you will not be deterred by commonplace ridicule from extending your munificence to this meritorious institution." They were not deterred. An act was passed for the incorporation of the proposed institute, and another which gave to female academies a share of the literary fund. The citizens of Troy contributed liberally, and the success of an effort for woman's high education was assured.

As early as 1697 the Penn Charter School was founded, and it has lived until to-day. Provision was made "at the cost of the people called Quakers" for "all children and servants, male and female, the rich to be instructed at reasonable rates, the poor to be maintained and schooled for nothing." They also provided for "instruction for both sexes in reading, writing, work, languages, arts, and sciences." The boys and girls have been taught separately, the girls' school being much behind the boys, neither Latin nor other ancient language forming a part of their curriculum. Friends are just beginning to discuss giving higher education to girls. This is a fact especially significant in our discussion, because it has always been claimed that the Quaker doctrine that "souls have no sex" led them to place woman on an "equality" with man before other sects had thought of allowing that they were equals. Lucretia Mott, Susan Anthony, Abby Kelley, and a great body of the women who adopted the resolution that set forth the uselessness of educating woman until she could vote, and who clamored for her entrance to men's institutions, were all of this sect that has kept its women generally far behind in the acquisition of knowledge.

In 1845 Mrs. Willard was invited to address the Teachers' Convention that met in Syracuse. She prepared a paper in which she set forth the idea that "women, now sufficiently educated, should be employed and furnished by the men as committees, charged with the minute cares and supervision of the public schools," but declined the honor tendered her of delivering it in person. Sixty gentlemen from the convention visited her at the hotel, and at their earnest request she read the essay, which met with their emphatic approval of the plan she proposed. The employment of women in the common schools and the system of normal schools were projected by her.

A teachers' convention was held in Rochester in 1852. Miss Anthony, though a teacher, was not in attendance upon it, but she records that she went in and listened for a few hours to a discussion of the causes that led to their profession being held in less esteem than those of the doctor, lawyer, and minister. In her judgment the kernel of the matter was not alluded to, so she arose and said, "Mr. President." She writes that "at length President Davies stepped to the front and said in a tremulous, mocking tone, "What will the lady have?" "I wish, sir," she said, "to speak to the question." "What is the pleasure of the convention?" asked Mr. Davies. A gentleman moved that she be heard; another seconded the motion; whereupon, she says, "a discussion, *pro* and *con*, followed, lasting full half an hour, when a vote was taken of the men only, and permission was granted by a small majority." She adds that it was lucky for her that the thousand women crowding that hall could not vote on the question, for they would have given a solid "No." The president then announced, "The lady can speak." "It seems to me, gentlemen," said she, "that none of you quite comprehend the cause of the disrespect of which you complain. Do you not see that, so long as society says a woman is incompetent to be a lawyer, minister, or doctor, but has ample ability to be a teacher, every man of you who chooses this profession tacitly acknowledges that he has no more brains than a woman? Would you exalt your profession, exalt those who labor with you. Would you make it more lucrative, increase the salaries of the women engaged in the noble work of educating our future Presidents, Senators, and Congressmen."

Several thoughts arise in regard to this scene, which was so strongly in contrast with the conduct of Mrs. Willard or any of the great educators. Miss Anthony gave no reason for her belief that the entrance of woman upon the other professions would raise either the status or the wages of those engaged in the teacher's profession, and as a matter of fact it has not done so. It was not the society that cast scorn at woman's "lack of brains" which assisted to remove the natural prejudice against her assuming duties that had been deemed unsuited to her physique and her necessary work.

Meantime, one year before the Rochester meeting was held, the first college for women had been chartered at Auburn, N. Y., under the name of "Auburn Female University." In 1853 it was transferred to Elmira, and it was formally opened in 1855. It was placed under the care of the Congregational Church, but its charter required that it should have representative trustees from five other denominations. Its course of study for the degree A. B. was essentially the same that was then pursued in the men's colleges of the State. It was expected to rely upon endowment, which put woman's education upon a new and more secure footing.

Suffrage leaders lose no opportunity to represent the Church as an enemy to woman's advancement. Nothing can be further from the truth; and in striking evidence stand the colleges, which, while unsectarian in spirit and in method, have been established and cared for by special religious denominations. Dr. Jacobi, in her book Common Sense, takes up the tale and says, "The Mount Holyoke Seminary, the immediate successor of that at Troy, was opened in 1837 by Miss Lyon, in spite of the opposition of the clergy." Many besides the clergy were opposed to the plan for which Miss Lyon was endeavoring to raise money. Her idea that the entire domestic work of the establishment could be done by pupils and teachers was thought unwise and hopeless; and it was simply this feature that they disapproved, not the school itself. In that noble school, where thousands of women have been educated, a great number have become missionaries. When a suffrage convention in session in Worcester wrote to Miss Lyon, asking her to interest herself in the wrongs of her sex, she answered, "I can not leave my work." Neither was Vassar College founded from any impulse or suggestion of suffrage agitators, but in a spirit exactly the opposite. The real impetus to its founding came from Milo Parker Jewett. He suggested to Mr. Vassar an endowed college for women, and visited the universities and libraries of Europe with a plan of organization in mind. Mr. Vassar gladly accepted this great enlargement upon an idea that had lain dormant in his own mind, and Vassar College was founded, Dr. Jewett becoming its first president in 1862.

I may claim to have been beside the cradle of Vassar College; for when Dr. Jewett resigned the presidency in 1864, my father named the successor, who was appointed, Dr. John H. Raymond, his lifelong friend. Dr. Raymond came to Rochester to discuss a plan of work, and, knowing my father's interest, I was on tiptoe to hear about the new college. At my earnest solicitation he and Dr. Raymond and President Anderson permitted me to be present at their discussions. I learned to comprehend the value of womanliness to the world by the estimate that those noble educators put upon it. It was evident that they were arranging for those for whose minds they felt respect. They made no foolish remarks about the superiority, inferiority, or equality of the sexes, and had no contempt to throw upon the old education of tutor and library and young ladies' seminary. They did not sneer at the "female mind," but they did talk of the feminine mind as of something as distinct in its essence from the masculine mind as the feminine form is distinct in its outlines. To "preserve womanliness" was a task they felt they must fulfill, or the women for whose good they labored would one day call them to account. The dictum so frequently in the mouths of suffrage leaders, "There is no sex in brain," would have been abhorrent to them. In their view, there was as much sex in brain as in hand; and the education that did not, through cultivation, emphasize that fact, would be a lower and not a higher product. They laid that intellectual corner stone in love, and in the faith that the same womanly spirit which, when there was not college education enough to go round, had said, "Give it to the boys, because their work must be public," would find, through the glad return the boys were making, a way to teach the world still higher lessons of womanly character and influence. Since that time college after college has arisen without a dream on the part of the founders, faculties, or students that "every effort to educate woman, until you accord to her the right to vote, is futile and a waste of labor," and it may well be that the women educated in these colleges will decide that, because political rights do acknowledge sex, therefore the word "male" should not be stricken from any State Constitution.

Before the committee of the New York State Constitutional Convention in 1894, Mr. Edward Lauterbach, who was arguing in favor of woman suffrage, said: "It was only after the establishment of the Willard School at Troy, only after its noble founder, believing that women and men were formed in the same mold, successfully tried the experiment of educating women in the higher branches, that steps for higher education became generally taken." If Mr. Lauterbach imagines that Mrs. Willard was in the most distant way an advocate of woman's doing the same work as man in the same way, he is unfamiliar with her life and work. Mrs.

Willard, in setting forth her ideal of woman's education, said: "Education should be adapted to female character and duties. To do this would raise the character of man. . . . Why may not housewifery be reduced to a system as well as the other arts? If women were properly fitted for instruction, they would be likely to teach children better than the other sex; they could afford to do it cheaper; and men might be at liberty to add to the wealth of the nation by any of the thousand occupations from which women are necessarily debarred." Old-fashioned wisdom, but choicely good.

In a woman's club, last winter, a New York teacher, Miss Helen Dawes Brown, a graduate of Vassar College, founder of the Woman's University Club and also one of the founders of Barnard College, in a speech said in part: "The young girl who doesn't dance, who doesn't play games, who can't skate and can't row, is a girl to be pitied. She is losing a large part of what Chesterfield calls the 'joy and titivation of youth.' If our young girl has learned to be good, teach her not to disregard the externals of goodness. Let our girls, in college and out, learn to be agreeable. A girl's education should, first of all, be directed to fitting her for the things of home. We talk of woman as if the only domestic relations were those of wife and mother. Let us not forget that she is also a granddaughter, a daughter, a sister, an aunt. I should like to see her made her best in all these characters, before she undertakes public duties. The best organization in the world is the home. Whatever in the education of girls draws them away from that, is an injury to civilization."

At the close of an article in The Outlook, written by Elizabeth Fisher Read, of Smith College, she said, speaking of their last adaptation of athletics: "From the beginning, the policy of Smith College has been, not to duplicate the means of development offered in men's colleges, but to provide courses and methods of study that should do for women what the men's courses did for them. Emphasis has been put, not on the resemblances between men and women, but rather on the differences. The effort has not been to turn out new women, capable of doing anything man can do, from walking thirty miles to solving the problems of higher mathematics. Instead of this, the college has tried to develop its students along natural womanly lines, not along the lines that would naturally be followed in training men."

This sounds strangely like Mrs. Willard, who would be the first to rejoice in the new education and in the old spirit that it can develop. Of course, suffrage claims to have the same end in view. Every college woman must decide for herself where she will stand on the question. So far, there never has been any open affiliation between the colleges and the suffrage movement.

The kind of education best suited to the idea of suffrage is a training in political history and present political issues; but the women who have talked loudly and vaguely of the right of suffrage for years have been the last to present such knowledge. I have read their History, attended their conventions, glanced at their magazines, but never have come upon the discussion of a single public issue. I think those most familiar with it will bear me out if I make the statement that their principal periodical, The Woman's Journal, edited by Mary A. Livermore, Julia Ward Howe, Mr. Blackwell, and Alice Stone Blackwell, has not contained any presentations of questions of public policy in the past ten years.

One of the grievances of the suffrage leaders lay in the fact that the literary women of the country would express no sympathy with their efforts. Poets and authors in general were denounced. Gail Hamilton, who had the good of woman in her heart, who was better informed on public affairs than perhaps any other woman in the United States, and whose trenchant pen cut deep and spared not, always reprobated the cause. Mrs. Stowe stood aloof, and so did Catherine Beecher, though urged to the contrary course by Henry Ward Beecher and Isabella Beecher Hooker. In a letter to Mrs. Cutler, Catherine Beecher said: "I am not opposed to women's speaking in public to any who are willing to hear, nor am I opposed to women's preaching, sanctioned as it is by a prophetic apostle—as one of the millennial results. Nor am I opposed to a woman's earning her own independence in any lawful calling, and wish many more were open to her which are now closed. Nor am I opposed to the organization and agitation of women, as women, to set forth the wrongs suffered by great multitudes of our sex, which are multiform and most humiliating. Nor am I opposed to women's undertaking to govern boys and men—they always have, and they always will. Nor am I opposed to the claim that women have equal rights with men. I rather claim that they have the sacred superior rights that God and good men accord to the weak and defenseless, by which they have the easiest work, the most safe and comfortable places, and the largest share of all the most agreeable and desirable enjoyments of this life. My main objection to the woman-suffrage organization is this, that a wrong mode is employed to gain a right object. The right object sought is, to remedy the wrongs and relieve the sufferings of great multitudes of our sex; the wrong mode is that which aims to enforce by law instead of by love. It is one which assumes that man is the author and abettor of all these wrongs, and that he must be restrained and regulated by constitutions and laws, as the chief and most trustworthy methods. I hold that the fault is as much, or more, with women than with men, inasmuch as we have all the power we need to remedy the wrongs complained of, and yet we do not use it for that end. It is my deep conviction that all reasonable and conscientious men of our age, and especially of our country, are not only willing but anxious to provide for the good of our sex. They will gladly bestow all that is just, reasonable, and kind, whenever we unite in asking in the proper spirit and manner. In the half a century since I began to work for the education and relief of my sex, I have succeeded so largely by first convincing intelligent and benevolent women that what I aimed at was right and desirable, and then securing their influence with their fathers, brothers, and husbands, and always with success."

Miss Beecher, like Mrs. Willard and Mrs. Phelps, made text-books for the use of her own seminaries, and her Arithmetic, and Mental and Moral Philosophy, and Applied Theology were among the educational forces of her day. It is one of the significant signs of the times that science and education, as well as philanthropy, are occupying themselves just now with childhood and motherhood and housewifery. Mrs. Willard's high ideal of womanliness is beginning to be set forth by the electric light of modern thought.

THE HISTORY OF ALCOHOL.

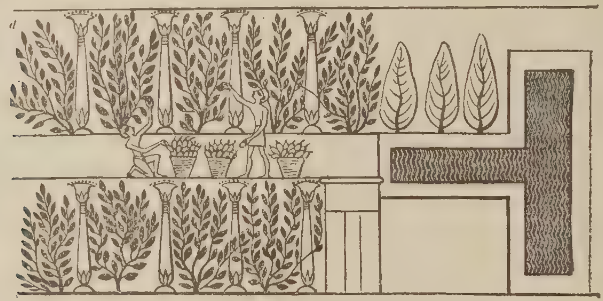
By Dr. CHARLES ERNEST PELLEW.

I.

IN studying the history of alcoholic beverages we are at once brought face to face with the fact that there has hardly been a nation on the face of the globe which has not used some variety of stimulant or narcotic. In almost every instance this has been some form of alcohol, and in a few cases where alcohol has been unknown, and tobacco, opium, hemp, or some other drug used in its stead, the introduction of alcohol has been followed at once by its use and, alas! its abuse. A curious example of this is given in the account of Henry Hudson's famous voyage in 1609, when he discovered the Hudson River. The Indian chief and warriors waited for him on the shore of Manhattan Island, prepared to sacrifice to the great "manito in red." He landed, with a few of his crew, and pouring out some rum into a glass, drank it to their health, and then passed a cupful round to the Indians. One after another they shrank from it, evidently fearing that it contained a deadly poison. At last one, bolder than the rest, drank it down, and soon began to reel and stagger, and finally fell. His companions were horror-struck. But soon he recovered himself, and described his drink in such glowing terms that they all begged and implored for their share, and, before Hudson left, they had all become intoxicated.

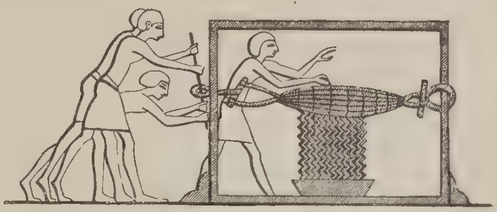
In other words, there seems to be a natural craving by man for some drug which shall "drive dull care away," and, as alcohol possesses this power, it has been used from the earliest ages and is still being used by rich and poor, high and low, civilized and savages, in more or less complete disregard of the evil effects of overindulgence.

The earliest historical records which have come down to us—the sacred classics of China, India, Judea, and Persia—all give details about the use and abuse of alcoholic beverages. The Chinese made use both of wine from grapes and of a beer made from rice, somewhat like the present *saki* of Japan; and, if we can believe their writings, intemperance was not at all confined to the lower classes, but in many instances proved the disgrace and the ruin of the reigning dynasties.



Egyptian Vineyard, with Reservoir of Water. (Wilkinson.)

The Rig-Veda, or sacred books of the ancient Brahmans, give us many details about the Hindu drinking customs, which were, among the upper classes at least, closely connected with their religious observances. The common people drank a variety of beer, known as *sura*, made from rice, barley, honey, and other ingredients. This was cheap and freely used for intoxicating purposes, and was, accordingly, in great disrepute among the priesthood and rulers, who made most stringent rules and regulations against it. But they were full of the praises of the sacred wine, *soma*, made from the juice of certain plants, which, after fermentation, was offered as a libation to their favorite gods, Indra, Vishnu, and others. These deities were supposed to drink *soma* freely, and to be highly gratified at the resulting intoxication. These exercises were particularly pleasant because it was not necessary, in order to honor the gods, to pour out all the wine upon the altar, but the act of devotion might be equally well performed by the worshipers drinking the libations themselves. Of course, the pleasant after effects were considered as solely due to the divine favor, and not to any ingredient common also to the vulgar *sura*.



Wine Press of Matting. (Wilkinson.)

In the Bible we find frequent references to both the good and the evil effects of wine. In such marked contrast do some of these passages stand that serious effort has been made, by many well-intentioned moralists, to attribute all the favorable comments—"Wine that maketh glad the heart of man," "Thou hast put gladness into their hearts since the time that their corn and wine and oil increased," and the like—to unfermented grape juice or to the fruit itself, and to apply to the fermented juice, the wine of our everyday life, only the passages, so well known and so frequently quoted, of condemnation. Some grounds for their belief exist in the fact that two Hebrew words, *yayin* and, *tirosh*, occurring in the Old Testament, are both translated in the authorized version as "wine," although *yayin* is almost always mentioned with scorn and contempt and *tirosh* with approval. But this is not always the case. The substances meant by both words are condemned alike in a chapter in Hosea (Hosea, iv, 2). And, furthermore, it is very doubtful whether the unfermented grape juice is not mentioned under an entirely different word, *debish*, translated as honey. In that hot climate, with no glass jars and rubber stoppers in which the sterilized grape juice could be preserved, and with no antiseptics to delay or prevent fermentation, the fresh grape juice must have been at once boiled

Pressing the Grapes and Storing the Wine. (Wilkinson.)

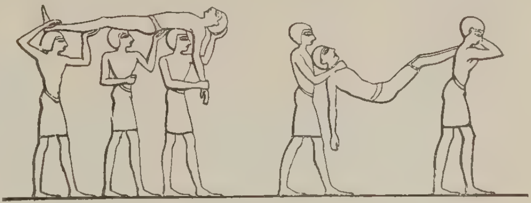
down to a thick sirup, or it would have begun to ferment in half an hour. That is the present practice in Syria, and the resulting *debs* is used to this day as a substitute for honey or sugar for sweetening purposes. And our respect for the wisdom of King David and other great men of Judea hardly permits us to think that their enthusiastic language was used about a sweet, cloying sirup.

There is no reason at all to doubt that the Greek word οἶνος, used in the New Testament, refers to the ordinary fermented wine; and, on the whole, it seems evident that in both Old and New Testament the commendations and denunciations refer to the use and abuse of alcohol, respectively, rather than to any specific differences between the beverages employed.

The ancient Egyptians at a very early date discovered the art of making barley wine, or, in other words, true beer, as well as grape wine. They have left evidences of this, not only in their writings and in the tales of early travelers like Herodotus, but also in several remarkable series of mural paintings found on their monuments. The most interesting of these are at the tombs of Beni-Hassan, where, some five thousand years ago, the Egyptian artists amused themselves by portraying the scenes of everyday life in a most graphic manner. We find there pictures of vineyards, with the vines carefully trained on trellises, and watered from artificial reservoirs. We find several varieties of wine presses—some for treading the grapes, some for pressing the grapes by twisting them tight in a bag. We can see how they poured the fresh wine into jars for fermentation and storage. We can watch them drinking their wine like gentlefolk, in the

Taking Wine like a Gentleman. (Wilkinson.)

bosom of their family, with wife by the side and children on the knee. And, finally, we find pictures of them using wine like beasts—men being carried home from supper on the backs of slaves; women staggering round, hopelessly and indecently intoxicated. Verily "there is nothing new under the sun."



After a Supper. (Wilkinson.)

The ancient Persian writings, the Zend Avesta, dating back to the period of Zoroaster, possibly 4000 to 6000 B. C., contain like the Rig-Veda many references to a sacred drink, *homa*, and a popular drink, *hura*. Wine seems to have been of somewhat later discovery, but, once introduced, proved extremely popular. The lowlanders, living in the rich, warm plains of Asia Minor, were especially addicted to its use, and the temperate young prince Cyrus, coming down from the mountains with his Persian warriors, found little difficulty in routing the effeminate Medes. But the attractions of luxury proved too strong for them, and, in a few generations, both rulers and people had badly degenerated. The famous Xerxes, the Great King, the descendant of Cyrus and monarch of Asia Minor, left as his epitaph no great record of valiant deeds, but the sole fact that "he was able to drink more wine than any man in his dominions." Small wonder, then, that his forces were so easily routed by the Greeks.

For, of all races that have yet appeared, the Greeks have been best able to use alcoholic beverages freely and yet with temperance. Their land was fertile and their crops varied, and they early learned how to prepare intoxicating drinks from barley, figs, the palm, and other sources. And their wines, especially those from the Greek islands, have retained their reputation, not for hundreds but for thousands of years. The vine was widely cultivated, and valued as one of the greatest gifts of the gods to man; and yet, such was their respect for the human body and such their dread of injuring it by excesses, that we

A Woman Intoxicated. (Wilkinson.)

find that, in their golden age at least, alcohol was used and not abused.

Their strongest drink, we must remember, was natural, unfortified wine, containing no more alcohol than our present clarets and hocks. And yet they never drank it pure; they always added water to it, or rather, added it to water. Some of their wines, the Pramnian and Maronian, for instance, were of such strong flavor as to be mixed in the proportion of one to fifteen or one to twenty parts of water. The average dilution was one to five, or one to four. When the young bloods of Athens had a supper party they would elect a "master of the feast," who sat, crowned with flowers, at the head of the table, and set the pace for the festivities. A very festive youth would sometimes at these occasions order the wine one to three, or even two to three. To drink wine unmixed—well, that was ἐπισκύθισαι, to act like a Scythian, to be a beast and a barbarian.

Sleeping Dionysos. (From Greek bas-relief in the Campana Collection.)

It is not to be supposed from this that drunkenness was unknown, but in the golden age of Greece it was both uncommon and despised. Drinking with them was different from drinking among other nations; they drank for exhilaration, not for intoxication. This can be recognized at once from the character and position of Dionysos, their god of drink, corresponding to the Roman Bacchus. No drunken debauchee was he. His statues represent him as a laughing, innocent child, as a beautiful, graceful youth, as a finely developed adult, and even as a gentle, refined, full-bearded man, the patron of literature and the drama.

For Dionysos was one of the greatest gods of Greece. At the vintage in the autumn all was fun and jollity, and in his honor rude, humorous plays were acted by the country people. Hence developed the "comedy," so named from κῶμος, the country cart from which the actors at first held forth. In the spring, at the opening of the new wine, occurred the great Dionysiac festival. Every one flocked to Athens, from the countryside, from all Greece, from the whole civilized world; and there, in the great Theater of Dionysos, the marble seats of which are still standing under the walls of the Acropolis, were acted the glorious tragedies of Æschylus, Sophocles, and Euripides, the noblest masterpieces of ancient literature.

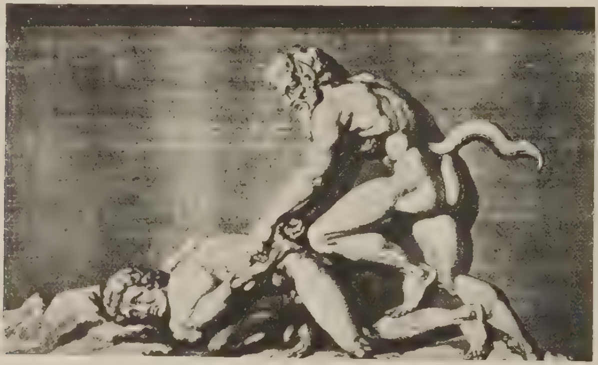
But after Athens and Sparta, and later Thebes, had wasted their resources and exhausted their energies against each other, a new and fierce and semibarbarous race came down from the mountains and conquered the whole of Greece. Under the famous King Philip of Macedon the weak and scattered clans united, learned the art of war, and rapidly overthrew the more civilized and cultivated lowlanders. This marked the end of Grecian temperance. The Macedonian nobles were always heavy drinkers, and toward the end of his career they were encouraged in their habits by the king himself.

Many stories have been handed down to us about the royal drinking bouts. One, which has passed almost into a byword, relates to a famous philosopher, who brought a lawsuit, in which he was a party, up before the highest court, the king himself. The case was heard and the judgment given against him. "I appeal," shouted the old man. "Whom do you appeal to?" said Philip, "I am the king!" "I appeal," said the other, "from Philip drunk to Philip sober." And the next day

Dionysos, from the Choragic Monument of Lysicrates.
(From The Antiquities of Athens, Stuart and Revett, 1762.)

the case was heard over again, and decided in the appellant's favor.

Another episode, which bade fair to have very serious results, happened the year before he died. He had recently divorced his wife Olympias, the mother of Alexander the Great, and was celebrating his marriage to a new wife, Cleopatra. At the wedding banquet, where the wine flowed very freely, her uncle Attalus made some insulting remarks about the young prince Alexander, who at once rose in his place at the table and threw a goblet at his head. This enraged the king, who sprang from his seat, drew his sword, and rushed at his son to kill him. But, in his rage and intoxication, Philip slipped and fell to the ground. Then Alexander, rather unfilially, shouted out: "See now, men of Macedon, this man, who is preparing to cross from Europe to Asia, can not step from one couch to another without falling!"



Satyr punishing a Sailor, from the Choragic Monument.

When Alexander came to the throne, a year later, the improvement in manners was but temporary. At first, indeed, the young king, with his companions in arms, devoted all their energies to affairs of state and war. Two years after he came to the throne he crossed the Hellespont, and with a small but picked army routed the vast, unwieldy hosts of the Great King. In a few campaigns he conquered Asia Minor, and even led his victorious forces into India. But with success came intemperance, and his brief and glorious career closed in disgrace.

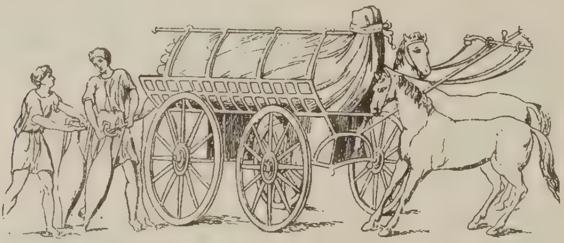
In the garb of Dionysos, accompanied by a band of drunken roisterers, he entered Carmania in triumph. At Samarcand, inflamed by wine, he killed with his own hand his friend Clitus, who had saved his life at the battle of the Granicus. At Persepolis, in a drunken frenzy, urged by dissolute companions, he set fire to the famous palace of the Great Kings, and although, sobered by the result, he urged his soldiers to the rescue, it burned to the ground.

His most famous exploit in this line took place, during the last year of his life, at the tomb of Cyrus, near Pasargadæ in Persia. He attended here the immolation of a famous Hindu philosopher, Calanus, who had followed him from India, and now, falling sick, burned himself alive on a great funeral pile. On his return from the ceremony Alexander asked many of his friends and chief officers to supper, and that night organized a great drinking contest, offering a gold crown to the victor. A young nobleman called Promachus took the first prize, with the respectable measure of some fourteen quarts of wine, and others followed close behind him. But a cold wind came up that night, chilling the revelers to the bone, and Promachus and some forty of his competitors died from the effects of cold and drunkenness combined.

Mænads in a Dionysiac Frenzy. A great figure of this sort, with splashes of blood on the garments, was one of the chief ornaments in the Dionysiac Theater. (From the Campana Collection.)

This course of life could not last long. His soldiers murmured, his officers grew unruly, his own strength failed; and, in his thirty-second year, after a drinking bout that lasted for two days and nights, a sudden attack of fever ended his career.

Turning from Greece to Rome, we find the same general course of events. At first the Romans were a band of fierce banditti, fighting first for life, then for conquest, against the surrounding tribes. During the few hundred years that this struggle continued the Romans were a temperate, a painfully temperate race. We read that wine was scarce and poor, and, such as it was, reserved exclusively for the men, and for men over thirty. Women were forbidden to use it under pain of death, for the alleged reason that it was an incentive to licentiousness. According to Pliny, this last law was by no means a dead letter. Women were obliged to greet all their male relatives with a kiss on the mouth, so that it could be told if they had been at the wine cellar. He quotes the case of one Ignatius Mecenius, who cudgeled his wife to death for this offense, about B. C. 700, and was pardoned by Romulus for the deed; and he tells of another case, four hundred years later, where a Roman dame was starved to death by her relatives for similar reasons.



Delivering Wine. (From a wall painting at Pompeii.)

Later on, when they had conquered most of Italy, wine became more common, and when the Roman arms reached Greece and Asia Minor the country was flooded with it. We learn from contemporary writers that manners and customs changed within one generation. Old Cato used to tell how, at his father's table, only common Italian wine was served, and that sparingly, while the Greek wine was handed round as a great luxury in small glasses at dessert. And before his death one general, Lucullus, returning from the East, distributed one hundred thousand gallons of fine Chian wine to the populace.

The later Romans cared more for their wine than for any other natural or artificial product of land or sea. Pliny mentions that there were one hundred and ninety-five varieties in general use, of which about eighty were of fine quality. Common wine was extraordinarily cheap and abundant, so much so that it was a jest of the poets that it was less expensive than water. Fine sweet dessert wines were imported in large quantities from the Grecian isles, Chios, Samos, Lesbos, Mitylene, and the rest. And the famous Italian vintages, the strong, fiery Falernian, the rich Massic, the sweet Alban, the Cæcuban, Setine, Pucine, and others, sung by Horace and Virgil and Lucretius, held the palm over all their rivals, and in many respects must have compared favorably with those of the present day.

But most of them would have been spoiled for our tastes by the curious substances which were added to them, for flavoring or as preservatives. For instance, both in Greece and Rome it was a quite common practice to mix honey, and also various spices, myrrh and aloes and cloves. A more surprising admixture was that of salt water, which, in small quantities, one to fifty or so, was believed to greatly improve the flavor of fine wines. Indeed, most careful directions are given by the old writers about the quality of this salt water. It must be drawn from the ocean, some three miles from shore, on a calm day, when the sea was at rest. Another, and to us barbarous, habit was that of adding resin or pitch or turpentine, either directly to the wine, or by smearing the wine vessels before filling them. This is done in Greece up to the present day, and the modern traveler is asked in the taverns whether he wishes "foreign wine" or "resined wine"—*οἶνος ἐξότικος* or *οἶνος ρεσινήτης*.

In one respect they were fully our equals. They appreciated the value of age. We still, some of us, have our wine cellars, and "lay down" our wines for aging. We smack our lips over a glass of Château La Rose of '70, and think it old; while "Stuyvesant" or "Monticello" Madeira, from the beginning of the century, is doled out, on rare festal occasions, a few drops at a time, like a precious elixir.

But in Cæsar's day we hear of Hortensius, a well-known orator, leaving his heir ten thousand casks of good Greek wine in the cellar of his country house. Plump little Horace, always referring to his poverty, can still write to a friend and ask him to visit him at his humble cottage, and take a glass of Falernian laid down "Consule Planco," some thirty years ago. His patron Mæcenas used to give him wine—*Marsi memorem duelli*—that remembered the Marsian war, seventy or eighty years before. And we learn from Pliny that, in his day, there was still in existence some of a famous "cru" of wine, made in the consulship of Opimius, some two hundred years before. This wine, we read, was only used for flavoring other varieties. It was thick, so that it had to be dug out with a spoon, and dissolved in water, and strained before using it, and when the cover was taken off the jar it emitted a delightful, powerful fragrance which filled the whole room.

From the fall of the republic on, intemperance and licentiousness increased in Rome with rapid strides. Nothing more was heard of the old laws; the women drank just as heavily as the men. All the writers--Pliny, Juvenal, Seneca, Tacitus, Athenæus, and many more—are full of bitter complaints against the prevailing habits. No order, no decency, was observed at their feasts. They rapidly became regular drinking bouts, where not only host and guests, but even the freedmen and slaves, drank themselves to unconsciousness.

Prizes were commonly offered, at these, to the heaviest drinkers, and it was customary to use drugs to increase the normal capacity for liquor. A separate chamber adjoining the dining room bore the suggestive name of *vomitorium.* The emperors themselves did not disdain to encourage these orgies. Under Claudius a certain Caius Piso was promoted at court for drinking consecutively for two days and nights. One man, Torquatus, was actually knighted under the name of Tricongius, or "Three-gallon Man," for taking that quantum of wine, so it was said, at a single draught. The populace, the home army, and the court were all equally intemperate; and it is no wonder that, when once the outer defenses of the empire were broken through, the rest collapsed and fell to pieces before the onslaughts of the hardier, even if no less intemperate, Northern races.

THE PUBLIC AND ITS PUBLIC LIBRARY.

By JOHN COTTON DANA.

THE opponents of the system of free, tax-supported public schools never have been answered. That they are wrong in their position is not proved, as so many seem to think, by a simple reference to the great growth and seeming success of the free public-school system and its attendant free public library system in this country. An institution may thrive, may apparently fulfill the purpose for which it was designed, and may at the same time be working great harm to the people who have adopted it and maintain it and trust in it—a harm which may become apparent only after a long series of years, and apparent at first, even then, only to the most careful observer. It is a familiar fact that a great change in governmental policy may not produce its full effect for many decades. We are still in the dark as to what will be the final outcome, and especially the final effect on character, of the free public educational system.

The individualist opponent of that system says that the individual is the important thing. He contends that the individual is happiest when he has the maximum of freedom; that he best develops when he most fully reaps the rewards of his own exertions and his own self-denials, and most fully receives the punishment of his own indolence and his own prodigality—of his own failure to adjust himself to men and things about him. The mass, he says, may restrain the individual who would make an attack on others; it may refuse to affiliate with the individual who does not do those things which it thinks he should do. For the mass to do more than this, he says, is so to restrict individual activity and to prevent the play of natural forces as to make impossible the development of the only kind of individuals that can form the ideal society.

This is stating it crudely. It at least suggests, however, that the advocate of liberty has on his side some of the arguments gained from the study of biology and of history. The former seems to tell us that the fittest have survived in open fight—that only by this open fight do those more fit appear; the latter seems to tell us that the better government governs the least; that the only wise thing the ruler, whether king or majority, can do for the social organism is to let it alone.

If it is of doubtful expediency, then, for the sovereign majority to take from the individual by force the means wherewith to maintain a library for the pleasure and edification of all, it is the part of wisdom to see that that library is made, as far as may be, the sure antidote to the possible bane of its origin. It must teach freedom, by its contents and by its administration. It must cultivate the individual. It must add to the joy of life. Always it must truly educate.

It is in the light of the preceding, perhaps rather doctrinaire, remarks that the following notes have been written and should be read.

The public owns its public library. This fact sheds much light on the question of public library management. It means that the public library must be fitted to public needs. It must suit its community. It must do the maximum of work at the minimum of expense. It must be an economical educational machine. It must give pleasure, for only where pleasure is is any profit taken. It must change in its manner of administration with the new time, the new relations of books to men and of men to books. It need not altogether forget the bookworm or the belated historian, and it can take note here and there of the lover of the dodos and the freaks among printed things. But its prime purpose is to place the right books in the proper hands, to get more joyful and wise thoughts into the minds of its owners. The means of its support are taken by force from the pockets of the competent and provident; this fact should never be lost sight of. It lives in a measure by the sword. It can justify itself in this manner of securing its support only by putting into practice the familiar theory that the state, would it insure its own continuance, must see that all its citizens have access to the stores, in books, of knowledge and wisdom. It must be open to its public; it must invite its public; it must attract its public; it must please its public—all to the end that it may educate its public.

The old-time library was simply a storehouse of treasures. There were few to read books; there were few books to be read, and those few were procured at great cost of labor and time. They could be replaced when lost or stolen only with great difficulty, if at all, and they were guarded with exceeding care. With the cheapening of book-producing processes the reasons for this extreme safe-guarding of books disappeared. Its spirit, however, is still active. Several causes have combined to keep it alive. Even to this day there are a few books, relatively very few, which are of great value and can be replaced only with extreme difficulty or at great expense. There are also books—first editions, fine bindings, last surviving copies, and early specimens of printing—which are rightly much prized by the artist, the antiquarian, the curio hunter, or the historian of handicraft. These are all most properly regarded as treasures, and are kept under lock and key. But the fact that there are a few books which should be carefully preserved from loss or injury is not sufficient cause for keeping up in these days a barrier between the public and its library. Set aside these greatly valued books and the few works highly prized for certain special reasons which the average library contains, and there is left the great body of modern books, not expensive, easily replaced, and of far more importance to ninety-nine in a hundred of any public library's constituents than all the book curios the world contains. In any save the very richest and largest libraries in this country the books which can not be duplicated at a reasonable cost have no proper place. It is with the modern, inexpensive works that the public library chiefly concerns itself. Its art publications and its rarities of every kind can easily be disposed of in safety vaults or private rooms. Its more valuable works of reference can be guarded from any probable mutilation by a little special service. Its main collection, sixty to eighty per cent of the average library, is what the public wishes to use. These form any library's real tools in its avowed purpose of aiding in the education of the community in which it is placed.

The readers of books, moreover, are no longer few but many, and have greatly changed their manner of looking at books and the guardianship of them in the past hundred years. The taxpaying citizen to-day has his own daily or weekly paper, if nothing more, and knows well that a printed page is no longer a sacred or an expensive thing. He walks up to the shelves of the bookstore or to the counter of the news stand and selects his own reading, under his own rules, in accordance with his own opinion of his needs, and after an actual inspection of what the shelves can afford him. He has learned, or is fast learning, that public library treasures are in the main treasures no longer; that the only rational selection of reading is one made after the examination of many books; and he is beginning to demand that he be permitted to come in immediate contact with the volumes he is invited to read. The public library, whether it be a library which the people are taxed to maintain or a library which belongs to them by gift, must, so the demand goes, be managed with as much consideration for its patrons and with as much appearance of faith in their honesty as the ready-made-clothing house or the bookstore. This demand is seconded by the new view of the functions of a public library; it is, in fact, a part of this new view. The library is no longer looked upon as a storehouse of learning, to be used by the few already learned; it is thought of as a factor in the growth of the community in wisdom, in social efficiency, and a factor therein second only to the public schools, if second even to them. It is accordingly widening its business of book distributing by the addition of the powers possible to it as a laboratory of general learning. Of books it is as true as of the materials of chemistry, botany, or biology—and even the non-literary, wayfaring man begins to see this—that only by working among them and with them can one get out of them their real worth. The public to-day, in a word, sees the importance—the absolute necessity, in fact—of the laboratory method in that study of books which underlies, or at least accompanies, the study of all other things.

In its attractiveness to the would-be student, not to mention the desultory reader, the library whose resources are open for examination and selection is far superior to the one which keeps its patrons on the outside of the delivery counter. The book buyer finds delight in a personal inspection of the volumes he would select from. It is by the unrestrained browsing through a score of inviting volumes that the student, whether beginner or expert, finds at last the one which meets his case. To all who are drawn, whether in ignorant questioning or in enlightened zeal, to visit a collection of books, the touch of the books themselves, the joy of their immediate presence, is an inspiring thing. Those who have had experience of both methods testify that the open library gives more pleasure, encourages reading of a higher grade, and attracts more readers than the library which is closed to the public.

The cheapness of books; the growth of the public's feeling of ownership in its library, and of the propriety of laying hands on its own; a recognition of the great educational value of the laboratory method in library administration; and the widening of its field of work which a library gains by the added attractions of free access to its shelves—these considerations, save in certain peculiar cases, seem to decide the question of the proper policy of the public library toward its public. That more communities do not now demand the adoption of the system of open shelves in their public libraries is due largely to the conservatism of library boards, and to an unreasoning submission to authority on the part of the reading public. Even the enlightened are slow to ask for a right before they have exercised it and experienced its advantages.

These statements of proper library methods will seem to the reader who is not familiar with public library methods as they are, simple, commonplace, and self-evident. He may well wonder why one takes the trouble to repeat them in print. By way of justification it should be said that the manner of conducting a public library now in almost universal use in this country is this: Between the books and the would-be users of them is placed an insurmountable barrier. At this barrier stand librarian and attendants. The reader or student flounders about in a list of the library's books until he arrives at a guess—it is often not more than a guess—at the titles of the books he wishes. A list of these books he hands over the barrier to the attendant, and of them the attendant brings him the first one that happens to be in. Perhaps he wishes to make a study of some subject. Generally, in such a case, he must make out a list from a brief catalogue of the books which he thinks may help him, and of the titles of articles which he surmises will be useful in files of periodicals or proceedings. This list, handed to the attendant, brings him some of the things called for. Half of them are probably not what he expected, and he must try again. Always between him and the sources of information the personality of librarian or attendant obtrudes itself. His wants must trickle over a library counter, and then must filter through the mind of a custodian who is perhaps not very intelligent and is probably not very sympathetic, before they can be satisfied by contact with the books themselves. In a good many libraries a few reference books are placed where any one can reach them. But this is in most cases the limit of the concession made to the demand for immediate contact with the library's resources. The new library in Boston has stored the most of its popular books, the books which the majority of its patrons most call for, in a dark warehouse, lighted only by artificial light, and reached, as far as the borrower is concerned, only by mechanical contrivances which compel a wait of nearly ten minutes for every book called for. The borrower can not see the books; he can not even see the person who does see them. He must depend on lists, telephones, pneumatic tubes, and traveling baskets—and this in the most expensive and most extensive and most lauded library in the United States to-day.

What, now, the open-shelf method of administration being decided upon, should be the character of the building in which the public library is housed ? The storehouse idea must be discarded at once. What is wanted is a workshop, a place for readers and students, not a safety-deposit building. The men and women who visit the library and use it—their convenience and comfort must be first consulted ; how the books are to be stored is another and a secondary question. Nor can the monumental idea be for a moment maintained. The library, if it is to be a modern, effective, working institution, can not forego the demands of its daily tenants for light, room, and air, and submit to the limitations set by calls for architectural effects, for imposing halls, charming vistas, and opportunities for decoration. The workshop, the factory, the office building, the modern business structure of almost any kind, these, rather than the palace, the temple, the cathedral, the memorial hall, or the mortuary pile, however grand, supply the examples in general accordance with which the modern book laboratory should be constructed. It is a place, is this book laboratory, in which each day hundreds and thousands of visitors must, for ten minutes or as many hours, use their eyes in reading type of all degrees of excellence and badness. First, then, every sacrifice must be made to secure all possible daylight in every corner. It is a place, again, in which many of the daily visitors will wish to go, at the same time, to the same shelves, the same cases, the same alcoves, or the same rooms, and the same desks and tables. Space —well-lighted, well-ventilated floor space—then, should be given to the public with the utmost prodigality. There is no room left, unless economy in construction and administration be entirely disregarded for architectural display, except as it is the natural outcome of plans based primarily on utility.

The power of a library lies first in its books. Up to a certain variable limit, varying with their character and with the time and the place, quantity of books is of first importance. As the library supported by compulsory taxation is justified only as it serves to make the ignorant citizen wise and the wise citizen wiser still, its first care should be for its supply of tools—its implements for cultivating wisdom—its books. The library building, as of the second and not of the first importance, should therefore be economical in its construction. It need not be, it should not be, penurious in its appearance. To a limited extent it may speak to the passer-by of the generosity of the community, of the respect in which its builders hold the business of education. But if solid and plain and manifestly adapted to the purpose for which it is designed, it can not well escape the attributes of dignity, and, to the reasoning observer, of beauty. The magnificent pile, to which architect and trustee can point the casual passer-by with pride, which may awe the taxpayer into forgetfulness of the contractor's bills, this has no excuse. It comes, and it promises to come often; but it is permitted by the populace in momentary forgetfulness of the public library's excuse and function, not in reasoned belief in the utility of bibliothecal palaces.

The free public library building, large or small—and of the college, university, or reference library the same may be said—so constructed as to serve thoroughly well the purposes for which it is intended, exists in theory only. It may be possible to find in this country a few small libraries in which an honest attempt has been made, with moderate success, to grapple with the library building problem. In the vast majority of cases such light as experience in library administration is able to throw on the question of the proper internal arrangement of a library building—the proper distribution of expenditure in securing room, light, ventilation, and workableness—has been simply ignored. Arguments drawn from utility, from comfort of readers and borrowers, and from economy of administration, have been set aside. Full rein often, the loose rein always, has been given to trustees' and architects' desires for architectural effect. This is the more strange because certain principles of library construction are well understood and are no longer matters for debate.

Convenient, economical, effective administration of a library calls for greater ease of access and facility of communication in the building used than does any other form of business, be it industrial, commercial, official, administrative, or religious. And this need for ease and speed in intercommunication increases rather than diminishes with the increase in the size of the library, and in the number of its patrons. Illustrations of how this general principle of library construction has been ignored may be easily found. To note the Newberry Library in Chicago and the Boston Public Library is here sufficient. Compare the accommodation possible for the busy and impatient patron—and the busy and impatient patron is one of the patrons the modern library should especially strive to serve—in these ill-adapted structures with that possible, with a few quite minor changes, in the modern tall office building, and the point is made clear at once. The whole monumental style of library architecture is almost of necessity the greatest of handicaps on library administration. It may be said, of course, that it is sometimes advisable to erect first a noble monument, then to make out of it as good a library as its monumental character permits. Granted. But it should be thoroughly understood, when such a building is up for consideration, that it is a monument, not a library. When our architects have fully seized the modern situation in its demands and its materials; when the spirit which put up the lying exteriors of the Chicago World's Fair buildings, and thereby delayed our architectural emancipation by many a long day, has begun to die out, it may be possible to erect a thoroughly useful and entirely workable building which shall be in every part a library and also an artistic monument.

The point in the free public library to which the public comes in the largest numbers is the delivery counter. The public side of this delivery counter should be a room easy of access from the street, with cloak and toilet rooms near its entrance; well lighted, that catalogues and lists may be easily consulted, and that the work of the assistants may be done in the main without artificial light; large enough to accommodate comfortably the greatest crowd the library expects ever to attract; and so closed in that the talk and movement which necessarily accompany intercourse between visitors and the library staff will not disturb workers or readers in other parts of the library. A corner of this room, easy of access from the counter, should be devoted to the information desk, at which the stranger or the student will get prompt and courteous and full replies to all questions in regard to the library's methods and resources, and suggestions in regard to books or departments to be consulted on any specific topic. Near this information desk should be the desk at which borrowers' or members' cards, permits, etc., are issued. In the delivery room, or in a room opening from it, should be the catalogue resources of the library. The delivery counter should be so constructed as to serve as an aid in the transaction of business—as a means of communication, not as a barrier—between the assistants and the public. Near to it and easy of access should be the books of the lending department; nearest to it, those most used. If for good reason it is found necessary to forbid the public access to any part of the lending department, it may prove advisable to place such part at some distance from the delivery counter, and to move the books to and fro by means of lifts, belts, or like devices. But any plan by which the attendant, to whom a request for certain books is made, is prevented from easy access to them, stands in the way of the library's educational work, especially where the would-be borrower is himself denied the opportunity to see for himself, in any department, the books he would select from. If a book asked for is not in, another of equal or greater value on the same subject may be in. The borrower, denied access to the shelves, should at least have, if he wishes it, the benefit of the attendant's knowledge of this fact. A delivery service made up largely of mechanical contrivances may easily put into the hands of the public several thousand books in a day. It may serve a good purpose in so doing. It may find its proper field in performing part of the book-lending work in any large library. But it certainly can not compete, from an educational point of view, with a service in which the attendant puts himself for the moment in the inquirer's place, and himself goes to the shelves with an intelligent interest in the inquirer's wants.

Near the counter should be the catalogue room; and the private official catalogue of the library should be open to the public, if possible. Such an arrangement saves much costly duplication. It is also desirable to have the information about the library's books which is stored up in the catalogue room made available for the public at short notice.

Near the delivery room and not far from the main book room should be a special room for children, in which may be kept all juvenile literature, so arranged that the children may make their own choice from the shelves. This will prove a strong attraction to the young people, will increase their use of books of the better class, will free other parts of the library from the disturbance children necessarily entail, and will save time and labor at the delivery counter.

The room for reference work, if the whole library is not thrown open for this purpose, must be not far from the main book room, must be near the catalogue, and should be near the delivery counter. It should be so planned that those who come to the library simply for a book, or to ask a question, or on sight-seeing, will not be compelled to pass through it.

The retiring rooms and lunch rooms for assistants, the conversation or class rooms for special work, the rooms for rough work —as mending or binding and the manual part of the preparation of books for the shelf—the periodical room, and the newspaper room can all be placed at a distance from the library's real center, the delivery counter; though the last two must be near enough to the reference room to make it easy for readers in the latter to consult the current numbers of magazines and journals.

The office of the librarian in charge should be near to the delivery room, and preferably not far from either catalogue or reference room.

The books in the public library should be selected with reference to the people who will use them. The people who make use of the free public library are, sixty per cent or more of them, readers of little but the newspapers, the popular magazine, and novels. The reading room should supply, and generously, the newspaper and the periodical. The circulating department should put much thought and much energy into fiction. The fiction shelves, perhaps above all others, should be open to the public. If they are thus open, the question of how low in the scale of literature the library must descend in its selection of novels to attract as many readers as its income will permit it to supply will almost solve itself. Liberty to go to a collection of novels, embracing the best works of the best writers of all countries and all ages, will be attraction enough. It will not be necessary to put on the shelves books of the Southworth, the Roe, and the Mary J. Holmes school to draw to the library the ignorant and inexperienced. Such readers are wedded to their literary idols, not because they find them best, but because they know no others. They will not often take the evidence of expert or of catalogue that there are other good novels than those of which they have heard from fellow-readers in their own walk in life. But the book itself of the unknown writer, placed in easy reach, with attractive title, cover, and illustrations, will prove irresistible. Liberty to see, touch, peep into, and taste the new and heretofore untried will set the known and the unknown on the same plane in the mind of the inexperienced; and the unknown, if the better book and if selected with an eye to the library's constituency, will gain the day. The horizon of the inexperienced reader will, in such a library, soon widen. The devotee of mush and slush will, under her own guidance, following her own sweet will, almost unconsciously rise to a higher plane. She will be proud to think that she has found possibilities of pleasure in good authors whom she herself has had the wit to discover. The fiction list then will be long, but it will be select. Four to five thousand titles, many times duplicated, will cover the field.

With the shelves open, with full liberty of choice given, the obliging attendant will be all the more appreciated. He will obtrude no opinions and no advice, but will be ready and able to give both, if asked, or if opportunity offers. He will be supplemented with catalogues. And just as the library will make its fiction department—the department in which it will first reach, by which perhaps it can alone reach, from sixty to eighty per cent of its visitors—the most attractive and most carefully administered of all, so will it for this department best equip itself with aids and guides. It will have here catalogues of the most varied kinds—special lists, descriptive lists, like those of Griswold; historical lists, like that of the Boston Public Library; annotated lists, like that of the San Francisco Public Library; critical journals; and books and essays on the novel, its development and uses. In addition to all these things, it will tell the inquirer in which novels he can find set forth great historical characters and the prominent personages of fiction; in which he will find descriptions of notable scenes and historical events; in which are found rare psychological analyses, striking descriptions that have become part of the everyday life of the cultivated; and discussions of social, political, and religious questions; and which novels will best tell him of life in this city, in that country, on the sea. In a word, the public's free public library will recognize at last the public's demand for the novel; will not attempt to excuse it, to hide it, to make light of it, or to counteract it; but will make use of it as an educational force in itself, and as a point of departure to more serious things. The novel reader is not a hopeless case. If he be a confirmed novel reader and nothing more, he has at least the reading habit, and in his youth can in most cases be led from that habit to question and to think.

The reference room of the free public library is in some sort already here. Not a few libraries recognize the reasonableness of a demand on the public's part for access to dictionaries, encyclopædias, atlases, gazetteers, and the like. Under the modern view the whole library becomes, of course, a great reference room. But the reference department proper, even in the modern public library, should contain ample accommodations in the way of desks, tables, writing materials, etc., for the casual inquirer or the student.

In other departments the wants of the reader, the beginner in learning, should be first supplied, books for the specialist being added as rapidly and to as great an extent as actual demand makes advisable and funds in hand make possible. No money should be expended on mere literary curios or on historical knickknacks. The historical society and the antiquarian can look after these things, and should not have the public purse for their competitor.

In accordance with the general spirit of the open-shelf method of administration, great liberality should be shown in the issuing of library cards. To the library itself for purposes of reference every one who applies will, of course, be admitted, so he be clean and reputable in appearance. To become an accredited borrower of books from the library one should be asked to do no more than sign some simple form of agreement. This, in addition to the information which can be obtained from a few questions put by librarian or assistants, with perhaps a reference to the city directory, has proved to be enough in actual practice to prevent the issuing of cards to people who wish them simply to make way with the library's books. In spite of this fact, the custom still holds in most libraries of demanding not only the signature of the person who wishes to become a borrower to an elaborate contract—this signature to be written at the library itself—but also the signature of some accredited citizen who agrees to become responsible for the borrower himself. This is entirely unnecessary. The additional clerical work involved in the keeping of the two sets of names of borrowers and guarantors of borrowers, together with the labor necessitated by looking them up in directories and elsewhere, will cost more, save in very exceptional cases, than will the books which may be lost through the adoption of extreme liberality in the issuing of borrowers' cards. The people's money in this part of its library's administration, as in every other, should be spent rather in extending and making more easily accessible to the average citizen the library's resources than in setting barriers of red tape between the books and the people who own them and wish to use them.

SCIENCE AS AN INSTRUMENT OF EDUCATION.

By M. P. E. M. BERTHELOT.

THE part performed by science in the general education of the human mind and the progress of civilization has been often misconceived by pedagogues, hedged in as they are by the traditional formulas of classical teaching. I recollect having heard a conversation some twenty-five years ago between Duruy, then Minister of Public Instruction, and a general school inspector, in which Duruy spoke of the importance of the experimental sciences and the necessity of giving them a larger place in the school course. The inspector, proof against general ideas, and despising utilitarian results, the importance of which he could not comprehend, saw nothing in this but a kitchen school, good at most to teach future dealers in petroleum and coal. It would not be hard to find similar opinions among some of the blind partisans of classical instruction founded on the study of Greek and Latin.

Yet, if the material conditions of human life have been changed—if the accumulation of capital and the increase of the productive force of man's labor have gradually added to the general ease and given workmen a relative independence and rights which they did not formerly possess, and which are extending every day for the good of the race—such advance, we should never cease to recollect, is not due to literary studies or scholastic or religious or philosophical discussions, but is attributable essentially to the growth of science and to the increase of general wealth brought about by it.

This immense development of wealth and industry, as well as the correlative development of the liberal and democratic spirit, are due, we declare loudly, to the discoveries of modern science. If the supply of food at the disposal of the human species goes on continually increasing, it is not by the effect of logical reasoning or theological declamation, but by the necessary results of discoveries in chemistry, mechanics, and physiology, which have already transformed agriculture and will transform it still further in a near future. However slowly peasants may change their traditional practices, we have taught them how to get from a field in a given time, with the same amount of labor and expenditure, a much larger quantity of wheat than the field formerly produced, and we are, in this matter, still very far from the goal that science permits us to set before ourselves. It is in consequence of the progress of science that everybody, or nearly everybody, in France now eats the white bread which formerly only richer people could get. The number of cattle we raise in our pastures has increased in no less proportion during the past two centuries, and always by the application of methods created by science; and, by virtue of what those methods have accomplished, animal food has been made accessible to our workmen and peasants, to whom it was unknown sixty years ago. By virtue of discoveries in chemistry, sugar, a rare and exceptional luxury in the last century, is now produced in colossal quantities, and has become one of the usual foods of the people. It would be easy to extend indefinitely this enumeration of the ameliorations of the conditions of life achieved through science.

Now all these advances, I repeat, are not due to dialectic or literary discussions, but to the positive discoveries of the physical, mathematical, and natural sciences. I do not mean merely practical discoveries made empirically, but the chief part of this progress is attributable to the highest theoretical conceptions of the positive sciences. Thus all the modern industries of metals, stones, wood, work in materials of every sort, rest upon the general discoveries of chemistry and mechanics. So with the immense development of ways of communication, which every one admires and acknowledges has opened indefinite domains to commerce and industry. It has permitted a general distribution of products and wealth among all civilized peoples, while it has at the same time tended toward a certain continuity of the ideas and the intellectual and moral education of the nations. The last is a capital point, for it is the fundamental characteristic of science to belong particularly to no sect and no nationality, and to be the general domain of mankind.

It is important to recollect how this distribution in common of all the resources of the globe, which has resulted from the development of the ways of communication, has been realized. We should never forget that it is through the discoveries of astronomy that the course of ships across the ocean is directed with certainty, and that the general plan and detailed map of the continents and islands can be traced with an exactness hitherto unknown; that the findings of modern physics have revealed the theoretical laws of vapors and thermodynamics, which are applied daily to supplement and multiply man's labor in all industries; that the discoveries of chemistry respecting gases, combustion, and the preparation of iron and steel, added to the inventions of rational and applied dynamics, control the fabrication and operation of our machines, ships, and locomotives. In short, these marvelous advances have been accomplished through science alone, and not through a blind empiricism. I will not here dwell upon the wonderful facilities that have been given to life by such subtle discoveries of the physics of our time as the electric telegraph, the telephone, photography, and electric lighting; and I only refer by way of a reminder to the complete modification of the conditions of war effected through the very recent discoveries of science concerning explosive matters. I can not, however, pass in silence over the prolongation of human life, the mean duration of which has been doubled among civilized peoples during the past two centuries by the discoveries of physiology, hygiene, and medicine, in which some new advance is marked nearly every day.

All this progress and all this transformation of life have not been accomplished and will not be continued by chance or accident, but are the fruits of modern science. And this is why public opinion is every day demanding an increasing intervention of the methods and teaching of science in public instruction. This participation is, furthermore, not destined to be for the profit of the community alone, but by a necessary consequence is primarily profitable for individuals to whom, prepared by scientific instruction in their secondary education, it is all the time opening new professional careers.

While the necessity of science in secondary education is thus demonstrated by the most imperative reasons from the material and social point of view, it must not be supposed that science is less well adapted to the mental and moral education of the individual, and that it can not form minds capable of elevated conceptions and develop good citizens.

There are two courses in science corresponding to different aptitudes, but not contradictory—the mathematical course, deductive and rational, and the physical and naturalistic direction, founded on observation and experiment, combined with reason. Mathematics gives the young man a clear idea of demonstration and habituates him to form long trains of thought and reasoning methodically connected and sustained by the final certainty of the result; and it has the further advantage, from a purely moral point of view, of inspiring an absolute and fanatical respect for the truth. In addition to all this, mathematics, and chiefly algebra and infinitesimal analysis, excite to a high degree the conception of the signs and symbols—necessary instruments to extend the power and reach of the human mind by summarizing an aggregate of relations in a condensed form and in a kind of mechanical way. These auxiliaries are of especial value in mathematics, because they are there adequate to their definitions, a characteristic which they do not possess to the same degree in the physical and mathematical sciences. There are, in fact, a mass of mental and moral faculties that can be put in full play only by instruction in mathematics; and they would be made still more available if the teaching was directed so as to leave free play to the personal work of the student. Mathematics is the indispensable instrument of all physical research. But the physical sciences introduce new and most important elements into education. They rest chiefly upon other methods than mathematics, the teaching of which contributes to the evolution of the child and the manifestation in him of new faculties no less essential, mentally and morally. I mean the faculties of observation and experiment, the object of which is the knowledge of Nature, a thing which, different from geometry, is not acquired by reasoning. In the physical sciences we are slaves to a truth which is exterior to us and which we can not know except by observing it. The teaching of facts is worth most here, and should be given from the tenderest infancy. On this side, scientific teaching, and especially natural history, are necessary from the first years of secondary instruction, and it is a great mistake, I believe, to postpone it till the later years of study. Nothing is more suggestive or better fitted to develop the taste for the knowledge of things and for comparing them than the study of zoölogy and botany. Children acquire very early the fancy for collections, and morphological notions, so useful for the development of the arts and sciences, enter their young minds, we might say, insensibly and without forcing. They acquire at the same time the general idea of classification, which plays a very important part in all human knowledge, and the still more general one of the harmonious combination of organic systems into living beings. A delicate æsthetic sentiment thus gently insinuates itself into their minds.

In order that the elements of the natural sciences may have their full educational virtue, it is indispensable that they shall not be presented to children under the form of arid nomenclatures, dictated and learned by heart as a kind of task; a method very well fitted to give them a disgust for these sciences, which are, on the other hand, really most interesting and most entertaining. The teaching of natural history should be based on the sight of the objects themselves.

The teaching of the experimental sciences, such as physics and chemistry, should follow. It can not well be given before the period of youth, and should be associated with at least an elementary degree of knowledge of mathematics. Such teaching, properly presented, is adapted in the highest degree to shaping the intelligence and morals of the young man; because it furnishes him at once the precise idea of positive truth, that of the fact proved *a posteriori*, and the most general notion of natural law, or the relation between particular facts, which is determined not by reason or dialectics but by observation. Truth thus imposes itself with the irresistible force of an objective necessity, independently of our desires and our will. Nothing is better adapted than such demonstration to give the mind that modesty, seriousness, steadfastness, and clearness of convictions which raise it above the suggestions of vanity or personal interest, and are closely connected with the idea of duty. The habit of reasoning and reflecting on things, inflexible respect for the truth, and the obligation of always yielding to the necessary laws of the external world, communicate an indelible stamp to the mind. They accustom it to respect the laws of society as well as those of Nature, and to conceive of the rights of another and respect for him as a form of one's own duty and of his own personal independence.

Thus science plays a most important part in the mental and moral education of man. Besides forming useful citizens it makes men free from the prejudices and superstitions of former times. It teaches them how to combat the fatal forces of Nature by labor and will power, resting on the knowledge and direction of the natural laws, rather than by mystic fancies. Hence science forms free spirits, energetic and conscientious, more efficaciously than any literary and rhetorical direction. When scientific education shall have produced all its effects, politics too will be transformed, as industry has already deeply been. Both will become, to use a familiar term, experimental.

Furthermore, and contemporaneously with this recognition of the laws of phenomena, observation and experiment give power over Nature. Through this fact, more than any other, youth can be engaged and drawn by an unconquerable enthusiasm into a really scientific education. To control physical and moral evil in industrial as well as economical life, to strive to diminish suffering, poverty, and misery of every kind, and to make the effort by virtue of the immanent laws of things, was the generous aim of philosophers of the eighteenth century, and they depended upon scientific conceptions, as they unceasingly proclaimed, for the attainment of it. The same end should be sought in our new education, and thereby science will become fully educational.

Scientific education has therefore its own peculiar virtue, and it is by a deep misconception of its character and effect that the assumption has been made of reserving the monopoly of the full development of the mind for literary instruction. Literary education has hitherto found its highest and most efficient formula in the teaching of the ancient languages. The teaching of the modern languages is less efficient because modern literary culture was derived from ancient culture, and is still, in principle at least, subordinate to it. However brilliant and original our modern systems may be, they have not produced, in either literature or the arts, superior models to those of ancient, particularly Greek, culture. So far, then, as the essential object proposed in secondary instruction is the formation of cultivated minds, there is no reason for expecting equivalent results from the simple substitution of the teaching of living for that of the ancient languages. But a purely literary teaching, even if it preserves its form and intention, does not adequately meet the needs of modern societies. Everybody, even the most enthusiastic partisans of literary studies, demands the addition of a certain amount of scientific teaching as a subordinate affair, comprising at least the elements of the sciences, to which no cultivated man of our age has a right to remain a stranger, whatever place he may propose to take in society. We may go still further, for it is certain that the formula of classical literary teaching, even as thus comprehended, is not adequate to all the careers and fundamental needs of our period. A very large number of citizens demand another discipline, based on a more thorough knowledge of the sciences, which have become indispensable for practical life, as well as for the general direction of society. Human society does not live on art and literature alone, as it once did; it now lives more on science and industry. Hence the necessity for a scientific not less than for a literary teaching, not only from the practical point of view but also from that of mental and moral culture, and these should be given parallel with one another. This scientific teaching should not be exclusive any more than the literary teaching; and it should be complemented by a subordinate literary teaching to which no cultivated man should be a stranger. The ancient languages are not indispensable for the realization of this special kind of literary teaching, because it no longer constitutes the fundamental object of the new organism.

Two parallel courses of instruction, endowed with the same prerogatives—one founded essentially on ancient letters, with the addition of some scientific culture; and the other based on science, to which some modern literary culture is added—that appears to me the most desirable formula of our time, and that to which we are destined to be led by the force of events.—*Translated for the Popular Science Monthly from the author's book, Science et Morale.*

RICHARD OWEN.*

By President DAVID S. JORDAN.

EIGHTY years ago in America the feeling was becoming general that the age of competition was past, and that a new social and industrial era was about to begin. Benjamin Franklin held that if every man and every woman should work for three hours a day at something useful, poverty would be banished, and each one might spend every afternoon of his days and the whole afternoon of his life amid the consolations of philosophy, the charms of literature, or the delights of social intercourse. In the words of Robert Dale Owen: "Every one looked forward to the time when riches, because of their superfluity, would cease to be the end and aim of man's thoughts, plottings, and lifelong strivings; when the mere possession of wealth would no longer confer distinction—any more than does the possession of water—than which there is no property of greater worth."

William Maclure, a wise man and a learned geologist in those days, refused to invest money in the city of Philadelphia, giving as a reason that "land in cities can no longer rise in value. The community system must prevail, and in the course of a few years Philadelphia must be deserted, and those who live long enough may come back here and see the foxes looking out of the windows."

It is not strange, therefore, that Robert Owen, of Lanark, fresh from contact with the reforms in the Old World, and full of projects for the development of the New, found in William Maclure an ardent disciple and active co-worker.

Owen and Maclure did not overestimate the power of co-operation in the struggle of humanity with Nature, but they did overlook the fundamental law of Nature that co-operation means working together, and equality of reward must imply some degree of equality of effectiveness. "The fatal error" of the New Harmony Community, according to Robert Dale Owen, lay in their failure to recognize this law. No "industrial experiment," he continues to say, "can succeed which proposes equal remuneration to all men, the diligent and the dilatory, the skilled artisan and the common laborer, the genius and the drudge. . . . Such a plan of remunerating all alike will ultimately eliminate from a co-operative association the skilled and industrious members, leaving an ineffective and sluggish residue, in whose hands the experiment will fail, both socially and pecuniarily." In other words, no community can succeed in which the drones and the workers have equal access to the honey cells.

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* So far as I know, Dr. Richard Owen, of New Harmony, was not related to the famous comparative anatomist in London who bore the same name.

But though the project at New Harmony, judged by the measure of its founder's purposes, was a failure, still the influence for good of the men who, as a result of the experiment, became part of the life of the infant State of Indiana, is incalculable. New Harmony was located far in the backwoods, in the long-despised county of Posey, but for a time it was truly the center of American science, and to this day few names in the annals of our science are brighter than those of Le Sueur, Say, and the Owens.

To gain a just appreciation of the scientific career of Richard Owen we must consider for a moment the lives of the men of science whose dreams and projects he shared, and who were the companions of his youth. It was through the agency of William Maclure that most of these were drawn to New Harmony. Maclure was a geologist of note and an earnest student of social science. On leaving Philadelphia he planned to conduct at New Harmony a school of industry where the arts of the conquest of Nature should be taught to all. The essence of human progress, in his thought, was the increase of human knowledge. The farmer should cease to be a mere tiller of the soil, and should be trained to make the earth his benefactor. A man is better unborn than untrained. An unskilled laborer is a deformity, and they who toil should do so to the best advantage.

William Maclure published fortnightly at New Harmony a magazine called The Disseminator of Useful Knowledge, containing Hints to the Youth of the United States, from the School of Industry. Its motto was, "Ignorance is the frightful cause of human misery." Its subscription price was one dollar a year in advance.

This magazine was filled with wise reflections on social and political matters, having for lighter reading scraps of science and bits of useful information of every sort.

In the pages of the Disseminator the name of Thomas Say often appears. Say wrote on the shells of the Wabash. He followed Maclure from Philadelphia, and came down from Pittsburg in a keel boat, along with the notable company famous in the New Harmony Community as the "boat-load of knowledge."

Thomas Say had been with Long's expedition across the Rocky Mountains, and had already won fame as a naturalist and traveler. His papers on shells and insects were widely known. These investigations he continued at New Harmony. A close and conscientious observer, his work bears the stamp of a master mind. At his death in 1835 it was asserted that "he had done more to make known the zoölogy of this country than any other man." With a touch of his own modesty, one of his friends said that "he will be remembered ever as one who did honor to his country and enlarged the boundaries of human knowledge." A worthy monument stands to his memory over his burial place at New Harmony.

One of the most attractive of our pioneer naturalists was the artist, Charles Alexander Le Sueur, who was a native of France, but had lived for a time in Philadelphia, from which place he came to New Harmony in the "boat-load of knowledge." But before leaving France his fame had become widespread. He enjoyed the friendship and correspondence of Cuvier. He had been around the world as a naturalist in the celebrated voyage of Péron. He was one of the most careful of observers and had singular skill in drawing and painting animals. The turtles and fishes were his special subjects of study, and his pictures of them are among the most lifelike ever published. He had been the first naturalist to study the fishes of the Great Lakes and the first to examine the great group of fishes called suckers and buffaloes. He made large collections of the animals of the Wabash Valley, which he sent to Cuvier, and which are still preserved in the museum at Paris. A number of his water-color sketches remain; one, a small but very lifelike portrait of the old Governor Francis Vigo, I have seen in Indianapolis. Le Sueur painted the drop curtain of the theater at the Community Hall. It represented the Falls of Niagara, and to heighten the Americanism of the scene he painted by the side of the Falls that other great wonder of the New World, the rattlesnake.

When the community disbanded, Le Sueur returned to Philadelphia, earning thereafter, it is said, a precarious living by giving lessons in painting. Afterward he returned to France, where he became curator of the museum at Havre. Richard Owen was a great favorite with Le Sueur, and I have already published in these pages Owen's account of him and of the days when as a boy he waded barefooted in the bayous of the Wabash to gather mussel shells for the naturalist.

Dr. Gerard Troost, a Dutch geologist, was also a member of the community, and after leaving it he became State Geologist of Tennessee. He made a magnificent collection of minerals, which was purchased, it is said, by a society in Louisville for thirty thousand dollars.

Dr. Joseph F. Neef, a blunt, plain-spoken, honest man, was the teacher of New Harmony, and he was a great favorite with his pupils. He was born in Alsace, and in his early life had been both priest and soldier. He was a mathematician of great ability. After leaving the army he became an associate of Pestalozzi in his school near Yverdun in Switzerland. He was mentioned by Pestalozzi as an earnest, manly worker who did not disdain to occupy himself with the elements of science. Neef left Switzerland for Paris to introduce there the system of Pestalozzi. In Paris he met Maclure, and was induced by him to come to America. "It is my highest ambition," said Neef, "to be a country school teacher amid a hardy, vigorous community." And this he became in New Harmony.

He was an intimate associate of the Owens. His daughter Caroline became the wife of David Dale Owen, and Anne the wife of Richard.

There were besides these, who were a part of the community, other men of note in science who spent longer or shorter periods in the community as visitors. Among them was the eccentric, "mattoed" Rafinesque, whose stay was so short and whose story so long that I must pass him by with a word. Sir Charles Lyell was for a time the guest of the Owens.

Reared among such surroundings, and with such men as friends and teachers, it is not strange that the sons of Robert Owen were imbued with a love of Nature, nor that they formed high ideals of the work they should do in life.

Robert Owen, in accordance with his own theories, gave his children the best education which the world could offer, and they made good use of their opportunities. Robert Dale Owen, the eldest son, had a strong taste for philosophy and literature, and was long known as a charming essayist, one of that circle of writers who gave to the Atlantic Monthly its high literary character. He too was a part of the "boat-load of knowledge" and took an active part in the affairs of the community. He became a member of the State Legislature, and exerted a powerful influence in shaping the school system of Indiana. He must ever remain one of the prominent figures in the history of the State.

William Owen, the second son, died early at New Harmony.

David Dale Owen was the third son, and Richard Owen the youngest of the family. These two were intimately and constantly associated both in their early education and in their later work. They were alike in taste and disposition, and, if we can trust the portraits of David Dale Owen, they were very much alike in personal appearance. They were born at New Lanark, in Scotland, David in 1807, Richard in 1810. They studied first at home under private tutors, and afterward were sent to Hofwyl, in Switzerland, to the famous school of Emmanuel Fallenberg. Later they studied chemistry under the famous Dr. Ure in Glasgow, and in 1827 they came to America together in a sailing vessel, landing at New Orleans. Until 1832, when Richard Owen was twenty-two years old, he had never been separated from his brother for a single day.

David Dale Owen was especially interested in fossils and minerals, and was employed to label and arrange the large collection of Maclure. A part of the collection became his property, and formed the nucleus of the famous Owen Museum, containing some eighty-five thousand specimens. This was purchased by the University of Indiana for the sum of twenty thousand dollars, but it was in great part lost in the destruction of the museum building in the disastrous fire of 1883.

David Dale Owen spent most of his life as geologist in the public service. He was State Geologist of Indiana in 1837. Afterward he undertook government work in Wisconsin and Iowa. He spent five years as United States Geologist in field work in the region beyond the Mississippi. Then in turn he had charge of the State Surveys in Kentucky, Arkansas, and Indiana. He was State Geologist of Indiana at the time of his death, in 1860. His work was admirably and conscientiously performed, and as first State Geologist of several different States he set a high standard of public work which few of his successors have been able to follow. One of the most untiring of workers and most unselfish of men, David Dale Owen has left a deep impression on the history of American geology, and the students in the Geological Department of the University of Indiana are proud to do their work in the building named "Owen Hall."

Richard Owen spent much of his early life as a teacher. He served for a time in the Mexican War, commanding a company under General Taylor. At the close of the war he became his brother's chief assistant, and was the first geologist to explore the northern shore of Lake Superior. For a time he held a professorship in the Western Military Institute in Kentucky, and afterward a similar position in a college in Nashville. This position he resigned to become his brother's successor as State Geologist of Indiana. While engaged in the survey of the State the civil war began, and he became lieutenant colonel of the Fifteenth Indiana regiment, under a commission from Governor Morton. While in camp he read the proof sheets of his last geological report. He took part in the battles of Rich Mountain and Greenbriar, and was promoted to the rank of colonel of the Sixtieth Indiana regiment.

The following facts regarding the war record of Colonel Owen I quote from an address by Judge R. W. Miers, one of his students: "In the winter of 1861–'62 he guarded at Indianapolis four thousand prisoners captured at Fort Donelson. In the spring of the following year he was ordered to Kentucky, where his regiment was taken prisoners of war by General Bragg at Mumfordsville. Three months later they were exchanged. Although the regiment was paroled, Dr. Owen was not, nor were his side arms taken from him. On the contrary, General Buckner went out into the field where the regiment was guarded, and thanked Colonel Owen for his kindness to the four thousand Fort Donelson prisoners at Camp Morton. He was treated very politely by General Bragg, with whom he had become acquainted in the Mexican War."

Later Owen was in the battle of Arkansas Post, and took part in the campaigns of Sherman and Grant about Vicksburg. He was with General Banks in 1863 on the Red River campaign, and while thus engaged was elected by the trustees of the University of Indiana to the professorship of natural science. He accepted the position on condition that his place should be temporarily supplied till the end of the war.

On January 1, 1864, he assumed the duties of his professorship in the university, which he continued to fill for fifteen years. In June, 1879, at the age of sixty-nine, he resigned, an increasing deafness, the result of sunstroke, having made his college duties burdensome to him. He retired to his estate at New Harmony, where he lived until March 25, 1890. His death was a tragic one, caused by accidentally drinking a quantity of arsenical embalming fluid.

While connected with the university he continued his work for the United States Geological Survey, exploring New Mexico and Arizona. During 1869 he traveled widely in Europe and America.

Of Dr. Owen's work as a teacher I may speak briefly. Under the present system of elective study he would have been an ideal teacher, earnest, thorough, and inspiring. Under the old system his best powers were never called for. He had neither skill nor taste for the work of drill master. He taught those well who cared to learn. He believed in large freedom of the student. His students were on their honor, and those who had no honor abused their freedom. It was part of the vicious system which prevailed in our colleges in the last generation that learned men capable of the highest work, and full of the inspiration which comes from thorough knowledge, should be compelled to spend their time and strength in crowding the elements of various subjects upon unwilling and unresponsive boys. A teacher should have the opportunity to give the best that is in him, and to give this to those who are ready and worthy to receive it.

In 1872 Dr. Owen was elected President of Purdue University, the agricultural and mechanical college of Indiana, established under the Morrill Act. This position he accepted, but, as after two years the school still remained unorganized, he never assumed the duties of the office. He published an interesting report to the trustees on the proposed method of organization and government of the new School of Agriculture. Its discipline he had planned to place in the hands of a representative senate of students. The lower classes were to be divided into sections, each numbering ten to fifteen, and each section to be under the direct supervision of some member of the senior class.

Dr. Owen's scientific publications were very numerous. His favorite subjects were the significance of the contour of continents and the causes of earthquake action. His mind was especially attracted to the study of hidden causes in the development of the earth—that is, to those causes which we have not yet learned to associate with their effects. This difficult line of research involved a vast amount of reading in every tongue, and the breadth of his early education made such reading possible. His first important work, A Key to the Geology of the Globe, was an endeavor to show that the present features of the earth are all the results of fixed and demonstrable laws, like those governing the development of animals and plants. He believed that the earth was a great magnet, made so directly or indirectly by the heat of the sun. As a result of this, he thought that the axis and coast lines of both continents tend to conform to the axis of the ecliptic. The angular distance of twenty-three and a half degrees, which marks the northward extension of the sun in summer, he took to be a natural unit of measure in the structure of the earth.

Whether these relations are real or fanciful I have no means of knowing. Perhaps in the ultimate progress of science it does not matter, for many hypotheses must be framed and tested before we come to the full measure of the laws which regulate the changes in the earth's crust.

Dr. Owen was a gentle and reverent man, unassuming and unselfish in all his relations—a man of perfect courtesy of manners because of perfect courtesy of thought; a man whom everybody loved because his love went out to every one. He was the highest type of teacher, of naturalist, of scholar, of soldier even, because above all his was the highest type of man.*

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* The writer once gave a lecture at New Harmony in the old building which had been the Community Theater. Dr. Owen presided. He was then nearly eighty years of age and very deaf. He did not hear one word of the lecture, but he had the art of appearing to hear. To every point the speaker or the audience deemed good he responded with a smile of appreciation, the expression of perfect courtesy, the courtesy of the "gentleman of the old school," of which type Dr. Owen was one of the most perfect examples.

Editor's Table.

PERNICIOUS LEGISLATIVE ACTIVITY.

THE past winter has probably been the most remarkable on record for legislative activity. Although a considerable number of Legislatures has not been in session, owing to the adoption of the biennial system, those that have been at work appear to have spared no effort to give evidence of their wisdom and to add to the enormous volume of statutes that overwhelm lawyers and judges. In New York State the phenomenal record made by the previous Legislature was broken. Over thirty-five hundred bills were introduced in the Senate and Assembly, and of these over a third of them passed both Houses. Although figures are not at hand in regard to the activity of other Legislatures, the newspaper reports of their proceedings leave the impression that they have not been less productive.

It is not difficult to account for this remarkable phenomenon. Ever since the civil war, which gave a tremendous impetus to legislative activity both at Washington and at the capitals of the States, there has been shown a tendency to rely more and more upon laws to curb unamiable traits of human nature and to improve economic conditions. The old belief in the potency of Yankee energy and thrift to overcome the obstacles of life and of public opinion to bring wayward people into line with the best moral thought of the age has become much weakened. What has affected it most unfavorably of late is the business paralysis of the last few years. The result is that few people entertain the notion that anything can be done in the direction of either moral or industrial improvement without the enactment of some law.

Only a careful inspection of all the bills introduced and passed would enable one to make an adequate analysis of the subjects that have received legislative attention and treatment. But the accounts given of them in the newspapers indicate clearly enough their general character and tendency. They show a growing lack of respect for individual and corporate freedom and for the rights of property, especially the property of rich men. They appear to be based upon the theory that progress lies in the direction of regulating more and more the conduct of everybody, and of taking the money of the people that have it for the benefit of those less fortunate. But no argument is needed to show that this is despotism, although it is created in the name of the people, and that it is a reversion to a much lower state of civilization than the one to which the American people are supposed to have reached. Until this truth is realized, it is probably too much to expect that there will be any amendment of this deplorable evil of over-legislation.

The subject that has perhaps received the most attention is trusts. With many legislators it has been a kind of mania. As a consequence, a mass of bills has been proposed to regulate all large combinations of capital, from railroads and insurance companies to department stores—a new object of legislative hostility—and to increase to the furthest limit the burden of taxation put upon them. Although this mania has not been confined to any particular locality, Kansas and Oklahoma have been the worst victims. So unfavorable to capital has been some of the legislation of Oklahoma that the home offices of insurance and loan companies outside of the State have ordered their agents to take no more business. The possibility of such a result in New York State had doubtless much to do with the modification of similar bills at Albany.

Naturally, where there has been such a shameless disregard of the rights of corporations, little consideration has been shown for the rights of individuals. When a wave of despotic repression passes over a community it shows no favor; it treats all alike. One of the most characteristic bills of this class is that compelling school teachers to contribute a certain percentage of their salaries to a retirement or pension fund, to be managed by the municipalities in which they live. It is, of course, nothing less than a step toward the establishment of a system of civil-service pensions like the one that now exists in certain countries in Europe. The legislation against the wearing of hats by women in theaters, against playing football, against the organization of Greek-letter fraternities in State-aided institutions, etc., is equally worthy of the same despotisms.

It would be interesting to speak more at length of other legislation, proposed and enacted, such as the prohibition of gold contracts, the issue of scrip as money by State and county governments, the payment of bounties on agricultural products, and the exemption from taxation of certain manufacturing industries. Measures of this kind are sufficiently significant to merit special comment; they illustrate in a striking manner the growing tendency to interfere with private rights and to plunder one class for the benefit of another. Equally significant also is the New York State law to pay to every indigent family a certain sum for the care of each child; it is a practice that can not fail to revive in this country all the shocking social and economic evils of the old English poor law. Finally, it would be interesting to dwell upon the vicious assaults that have been made in New York, Illinois, and elsewhere upon civil-service reform; they indicate the same decadence in public opinion as to the requirements of good government that may be observed in the renewal of archaic legislation in the field of morals and economics.

But it is only possible to call special attention to the efforts made very generally to provide money to meet the alarming increase of expenditures that has followed the large addition to the duties of the State. Desperately pressed to discover new sources of income, legislators have resorted to many novel and extraordinary expedients. Of these the most iniquitous is the graduated inheritance tax enacted in New York and proposed in other States. Not only does it violate the fundamental principles of taxation, namely, uniformity and equity, but it is likely to serve, like all iniquitous legislation, as a precedent to violate still further the rights of individuals and of property.

THE POSTAL UNION CONGRESS.

The city of Washington is at this moment the seat of a congress strikingly different in character from the Congress which we are accustomed to associate with the national capital. It is a congress of men chosen for their competence to deal with a particular subject. It meets for a business purpose. It will attend to that business. It will attack difficult work and keep at it till it is done. It will not be the scene of vain eloquence, nor yet of party maneuvers. and will know nothing of log-rolling for appropriations. When its labors are concluded the result will be recognizable in rules established, disputed questions settled, methods of procedure improved, distinct advantages gained for the whole civilized world. It will afford an example, as previous congresses of similar nature have already done, of what can be accomplished by the mutual counsel and concerted efforts of a body of men chosen expressly for their recognized fitness to deal with the interests committed to their charge. If it does not teach a lesson as to the improvement which might be effected in legislative bodies could their members also be chosen on grounds of fitness and competency for the work of legislation, it will not be because the lesson is not sufficiently on the surface.

The congress referred to, as our headline shows, is that of the Universal Postal Union. The formation of the Postal Union may be regarded as marking the transition from a period of semibarbarism in postal matters—that is to say, from an international point of view—to a period of civilization. Prior to 1874 each nation followed its own devices so far as postal arrangements were concerned. There was no attempt at uniformity of postage rates or regulations, and all international relations were complicated in the highest degree. The postage charges to no two countries were the same; or, if they were the same, it was by accident. There was no accident, however, about their being high. It had not occurred to anybody as yet that there could be such a thing as cheap international postage. It seemed to be an accepted axiom that, if correspondence was carried on across a frontier, it must be made an expensive affair.

A far-sighted German, however, the late Herr von Stephan, of Berlin, conceived the idea of introducing order into this postal chaos. He did not see why, if uniform rates could obtain through the extensive territories of a single state, uniform rates might not also be established over the civilized globe. He saw no sense in international frontiers in postal matters. A letter, he held, should be free to go whithersoever its sender willed, at the lowest charge compatible with reimbursement of the expense of conveyance. And as, in the main, the correspondence which each country would send to any other country would be about equal to what it would receive therefrom, he saw no necessity for international accounts. The result of the communication of these ideas to a number of the leading postal administrations of the world was the summoning in the year 1873 of the Berne Conference. The result of the conference was the establishment of the Postal Treaty of Berne, to which the leading nations of the world were signatories. That treaty established a uniform international rate of five cents for a half-ounce (fifeen gramme) letter, with a provisional permission to levy a surcharge up to five cents more on correspondence addressed to very distant countries, and subject therefore to specially heavy "transit" rates. International accounts were in the main abolished. There were still, however, complications, arising from the fact that a great many countries were yet outside the Union, and that accounts had therefore to be maintained with these, and certain debits and credits in connection with their correspondence to be passed on to other countries.

As time went on, however, things simplified themselves gradually. One by one the outlying countries fell in; and at the present time there is no government on the face of the earth deserving the name of civilized that has not adhered to what is justly styled the "Universal Postal Union." Nearly all countries have voluntarily abandoned their privilege of surcharging letters for remote destinations; so that, broadly speaking, the whole world may be described as one postal territory, while a five-cent stamp is the talisman that will secure for a letter conveyance, from any point where it can be posted, to any other at which it can be delivered by postal agency. For that very low payment it may go half round the globe; and if the person addressed is not there, it may complete the circle in order to find him. The great empire of China is preparing to fall in with the scheme, and has already adopted it to a considerable extent. Japan became a full member of the union many years ago.

The task, therefore, of the postal unification of the globe may be said to be all but accomplished. One or two difficulties in the working of the system remain to be smoothed away, and these are engaging the attention of the present congress. The most important question is that relating to "transit" postage. Some countries are so situated geographically that they are required to handle far more correspondence for other countries "in transit" than those countries have any opportunity of handling for them, while the situation of others, again, is the exact reverse. France, Italy, and Belgium are countries of the first class, a vast volume of correspondence for the continent of Europe passing through France and Belgium, and most of the correspondence of Europe with the East passing through Italy. Great Britain is an example on the other side, the postal business it does with foreign nations far exceeding the use made of its territory by mails in transit. The consequence is that every year in the settlement of claims and counter claims Great Britain has to pay out nearly half a million dollars more than she takes in.

Heretofore these claims and counter claims have been established by means of statistics taken periodically, and the question now before the congress is, Can these statistics, which entail a vast amount of labor, and more or less impede the postal service while they are in progress, be got rid of altogether? The German post office has a scheme by which this object can be accomplished. The plan is briefly this: As the taking of the statistics costs a great deal of labor, which, of course, means money, it is proposed that countries having a less claim in the general clearing than ten thousand dollars a year should forego it altogether in consideration of getting rid of trouble and expense to that (supposed) amount, and that the same amount should be deducted from all claims exceeding ten thousand dollars. It is estimated that the making of these deductions would decrease the total amount to be paid by the debtor countries by twenty-five per cent; and, taking the latest statistics as a basis, it is proposed simply to assess each debtor country accordingly, and pay over to each creditor country the amount to which it is entitled. If this scheme commends itself to the congress, the international postal system will have reached nearly the acme of simplicity, all postage accounts between the different countries having been swept away into the limbo of the obsolete and the useless.

To how great an extent such an organization as the Universal Postal Union makes for civilization and for international unity it is needless to point out. It is one phase of the federation of mankind, and gives ground to hope that other steps in the moral unification of the race will follow. It is satisfactory to think that it is to a large extent the result of individual effort. The different governments of the world have been rather passive than active in the matter. They have had the grace—and they deserve credit for it—to let the best heads in their several services coöperate in developing this great scheme, which deserves to be regarded as one of the most definitive steps in advance that civilization has ever taken. When the proposition was first made it was not looked upon with great favor in more than one high quarter, but, as it did not involve much expenditure of money, no serious obstacles were thrown in the way. The thinkers who had it in hand soon showed what could be made of it, and to-day the world is reaping the benefit of their labors and their sagacity. As we began by saying, the congress of this world-wide union is a congress of the competent—let us add of the responsible. As it happens, these are precisely the two adjectives that are least applicable, generally speaking, to the members of political assembles elected by popular vote. As to competence, there is no need to discuss the matter; as to responsibility, it means nothing in political circles save liability to censure and rejection on the next occasion, if the representative has not pushed local interests with sufficient vigor and sufficient disregard of wider considerations. It would be vain to look for any sudden change in the working of democratic institutions; and yet an object lesson like that afforded by the Congress of the Universal Postal Union is one that should not be wholly lost on reasonable men.

Scientific Literature.

SPECIAL BOOKS.

Those interested to learn of their paleolithic and neolithic ancestors will find an interesting account of their conditioning in Prehistoric Man and Beast.* Although embodying the results of recent geologic and archæologic research, the book is not at all technical, but adapted to the popular reader. If he knows anything of scientific theory, he may be aroused by the epithets applied to the cherished hypotheses of some writers. The great ice sheet is called "a myth," the polar ice cap "a monstrous fiction," and the astronomical theory of an ice age receives no milder treatment in the chapter devoted to the discussion of the subject. But, having dealt as an iconoclast with these favored cults, the author writes of the lore of fairyland in an opposite fashion. Fairies are not legendary beings, but real folk, whom scientific people "may no longer dare to despise." The small, tricky natives of an island off the Schleswig coast were called Pucks, and even mermen and mermaids had their prototypes in a Finnish people who dressed in sealskins and were taken by the Shetlanders to be half human.

The record of primeval man is not found in documents produced by impressionable minds, but is registered in the river gravels, cliff caverns, kitchen middens, and long barrows. In these ancient dwelling places the weapons, utensils, ornaments, burial and hearth stones testify unerringly as to his mode of life. The degree of skill attained in his handiwork serves as a basis to differentiate the earlier races from those of later times. Men of the older stone age fashioned their weapons and tools in the rudest manner from rocks, merely chipping the edges. In the succeeding period, the neolithic, they had learned how to finish them by grinding; while in the bronze and iron ages they discovered the use of metals. It is somewhat remarkable that while it is a disputed point as to whether paleolithic man possessed a bow, it should be a well-attested fact that his wife used bone needles and knew how to sew.

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* Prehistoric Man and Beast. By Rev. H. N. Hutchinson, F. G. S. New York: D. Appleton & Co. Pp. 298, 8vo. Price, $3.00.

These authentic sources of knowledge concerning our early ancestors are not the only data to be studied. Primitive races exist whose habits indicate what prehistoric man may have been like, and the author pleads, "It is sincerely to be hoped they will not be improved off the face of the earth before we have learned all that they can teach us about the past."

Nothing definite is known concerning the place of man's first appearance on the earth, but probably the northern hemisphere of the Old World can claim the honor. This may have occurred fifteen or twenty thousand years ago, but the allowance of eighty thousand odd years is deemed an unwarrantable waste of time. The volume contains ten full-page illustrations based upon such details as the researches have furnished. Primeval man, however, is reconstructed without a skull as a model for his features. This feat must have tested the creative power of the artist, but we are assured that even this has been done acceptably to the archæologists, and we can not demur if it does not coincide with our ideal.

About one fifth of *Macleod's History of Economics* is really history.* The rest is exposition of basal principles. Macleod declares that economics should and can be as exact as physical science, and he is putting forth vigorous efforts toward making it so. He says that most of the modern economists' work up to this time has been destructive, but that constructive labors are now urgently demanded and that the ground has been fully cleared for them. His present work opens with an essay on the method of investigation proper to economics. He gives much credit to Bacon for enunciating the principle that physical inductive science must precede and guide moral inductive science and protests against Mill's declaration that induction should not be taken as the method of political economy. Having placed economics among the inductive sciences, our author proceeds to lay down some general principles of reasoning which this position makes fitting for it. "The fundamental concepts and axioms of every science," he says, "must be perfectly general," and "no general concept and no general axiom must contain any term involving more than one fundamental idea." The clarifying of fundamental concepts, in fact, is the chief object of this treatise. The historical portion comes next. He rejects the insular idea that political economy began with Adam Smith, and gives to the French Economists the credit for establishing it as a science, although certain of its principles had been fixed from time to time before them. He states the doctrines of the Economists regarding exchanges, money, wealth, productive labor, and other economic concepts, giving also the opinions held by the Roman and Greek jurists as to what things are wealth. He then discusses the views of Adam Smith, pointing out what he regards as Smith's chief merits and chief defects. In a similar manner the economic doctrines held by Ricardo, Whately, Say, Mill, Bastiat, Perry, and Jevons are critically examined. He also describes his own contributions to the science. In pursuance of his conviction that a great part of the confusion and false teaching in economics is due to lack of clear definitions, he devotes the remaining three fourths of the volume to setting forth the legal and scientific bases of the chief concepts of the science. Among these concepts are acceptilation, accommodation paper, banking, capital, currency, cost of production, credit, debt, exchange, Gresham's law, money, negative quantities in economics, rent, value, and wealth. Each is discussed with considerable fullness, particular attention being given to the early history of the ideas. Macleod is a vigorous and positive writer, and a study of his pages can not fail to substitute exactness for many hazy economic teachings.

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* The History of Economics. By Henry Dunning Macleod. New York: G. P. Putnam's Sons. Pp. 690, 8vo. Price, $4.50 *net.*

With modesty and excellent taste Mrs. *Rogers* has presented to the public, not a fulsome eulogy, but a view of her husband's life as shown in his letters, supplemented only by the necessary biographical facts and a paragraph here and there to explain and connect the matter from his own pen.* Many of the biographical facts she allows the late Dr. Ruschenberger to tell in extracts from his Memorial of the Brothers Rogers. The son of a physician and professor of science, to whose chair in William and Mary College he succeeded at the age of twenty-four, William B. Rogers was early introduced into the field of scientific education, in which he did masterly work up to the last hour of his life. There was not much money available for the support of science in the United States during the thirties, and the teaching and research of Prof. Rogers were carried on with very limited resources. His means, moreover, were frequently drawn upon for the benefit of his brothers, who were struggling in the same field with rather less material success than his. In 1835, at the age of thirty-one, Prof. Rogers was appointed State Geologist of Virginia, and in the same year was called to the chair of Natural Philosophy at the University of Virginia, which he retained until 1853. The geological survey was allowed by the State Legislature to continue for seven years, and furnished the occasion for undertaking what was Prof. Rogers's most extensive contribution to natural science. The letters exchanged between William and his brothers reveal something of the turbulence of hot-blooded students and the paralyzing influence of narrow-minded authority with which many science professors had to contend half a century ago. All the important discoveries and controversies that mark the history of geology in this century are discussed or at least remarked upon in these letters. In the diction of many of the epistles, and especially in that of extracts from several addresses that are inserted in the volumes, we find all the evidence that can be given without his living voice as to the powers of oratory with which Prof. Rogers has been credited. We are especially impressed with the testimony of these volumes to the ability of their subject as an educational organizer. This is shown especially in his Plan for a Polytechnic School in Boston, and his labors in furtherance of the scheme, which resulted in the establishment of the Massachusetts Institute of Technology. His grasp of modern educational conditions is shown also in documents which he presented to the Legislatures of Virginia and Massachusetts in behalf of the institutions with which he was successively connected. Ability of the same sort appears in the part that he took in organizing the American Association for the Advancement of Science, the American Association for the Promotion of Social Science, and the National Academy of Sciences. His death in 1882 closed a career of marked influence upon the advancement of science in America.

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* Life and Letters of William Barton Rogers. Edited by his Wife with the assistance of William T. Sedgwick. Boston: Houghton, Mifflin & Co. Two vols., 12mo. Price, $4.

GENERAL NOTICES.

In order to judge fairly of the key to the problems of the universe furnished by Mr. Silberstein,* it is not only necessary for one with scientific habit of thought to subdue this mental temperament, but to place himself in that receptive frame of mind with which he should attend a *séance* or view an impressionist picture. However easy this may be for the metaphysician, it is almost impossible for the physicist or chemist, who, without his rule of verification, is more helpless than a rudderless ship at sea.

This comprehensive work is well divided into four chapters: The Idea of God, The Creation, Matter and Force, and Universal Mechanism.

As the conception of a machine precedes its manufacture by the mechanic, so the universe in its potential being antedates the physical universe which is individualized from it. The abstract concept of the universe as a whole is absolute intellectuality or God. This conclusion is reached by the *a priori* method of pure reason. The cognition of man, which concerns itself only with the perception of things manifest to the senses, is no knowledge at all. It teaches us nothing of true entities. We observe bread and man as two different things, and also that they are mutually convertible. If they were real existences, "how could they merge one into the other?" Hence "we are forced to assume that the entity of any compound object as it appears within the limits of time is not real. . . . Thus the science of experience and experiments alone, of which our naturalists are so proud, and which they call 'exact knowledge,' is a delusion." All the causes which exist in the universe are bound up together in the knowledge of the causes. If man knows one cause, he knows all causes of eternal existence. Man, however, knows that he does not know, and in this comprehends the whole knowledge of the entire universe. He thus arises to Divinity itself, and human intelligence is identically the same with the one absolute knowledge.

In regard to the Creation, we learn that the universe consists of two kinds of existence, sensual and intellectual. "The existence of any Creator before the creation in time, or behind it in space, is an impossibility." Matter can not contain in itself the absoluteness of existence. Man as a material being is an accident of changeable matter. The creation of the universe is an eternal emanation of the Absolute Intellectuality. The essence of the universe vibrates in spiritual waves. Physical waves, which appear in various forms of energy, magnetism, electricity, heat, and light, are contained in these.

In Matter and Force we are given a *résumé* of the theories of various philosophers from Thales to Spinoza. Many modern philosophies are considered. They differ from that of Spinoza only in their names. "One calls his system Positivism, the other Materialism, the third Skepticism, the fourth Evolution, but they are all one in the Spinoza fanaticism." Among others Newton came, and through his mistaken theory of gravitation "reduced mankind to a still lower degree of pure wisdom." Chemists have also led the world astray with their inductions.

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* The Disclosures of the Universal Mysteries. By Solomon J. Silberstein. New York: Philip Cowen, 1896. Pp. 298. Price, $2.

The law of the union of gases is extremely repugnant to the author; "even if proved by ten thousand mathematical calculations, it is yet a natural impossibility, because these calculations are based upon false axioms."

Under the head of the Universal Mechanism the laws of motion are discussed. The property of inertia in matter and the first law of motion are said to be "absolutely false," while the author promises to "entirely annihilate" the force of gravitation. Instead of these, he gives us centrality, "a power of conservation whose impulse is to keep an atom or a body in its peculiar state or form." Inertia is accordingly "nothing else than centrality holding each physical object in its chemical bond. . . . Centrality is an active force, while the force of motion is passive." Another argument is furnished to show that "chemical combination has only to do with the *qualities* of objects." Even if the laws of gravitation were correct, "it would be a natural impossibility that the moon should have an elliptical motion around the earth."

Those who prefer the idealistic to the scientific method of explaining the mysteries of the universe will find the book of interest.

The results of over two hundred experiments on phenomena connected with the X rays have been collected in a volume by *Edward P. Thompson.** The book is designed for students and workers in electricity, hence no attempt has been made to render it attractive to the general reader. Many of the experiments were made before Röntgen's famous discovery was announced, some dating back to the time of Faraday, so that those who made them of course had no idea of their connection with the X rays. Among the special points that the experiments bear upon are the action of a magnet on the cathode light, photo-electric dust figures, mutual repulsion of cathode rays in the discharge tube, behavior of cathode rays outside the discharge tube, effect of the X rays on various chemicals, and penetrating power of the X rays. We note the following well-known names among the investigators whose work appears in the volume: Faraday, Davy, J. J. Thomson, Crookes, Lenard, Röntgen, Edison, Tesla, and Lodge. The text is illustrated with a large number of reproductions of skiagraphs and other pictures.

The authors of *Curiosities of Medicine* have been working a very fruitful field, and doubtless could have gathered an even larger harvest.* Although medical journals are constantly reporting curious cases of abnormal formation or of recovery after injury, the present volume appears to be the first systematic collection of such material. To the physician a knowledge of such cases may often be of service in indicating what hope there may be for ameliorating similar abnormal conditions that may occur in his practice. To the layman the collection is one of startling and often rather painful interest. Instances of children born joined together, of which the Siamese twins have long been the traditional type, are well represented. With these are classed persons with supernumerary limbs, heads, and other organs. Minor abnormities present a wonderful variety, including albinism, excessive hairiness and hairlessness, elastic skin, horny growths, large or small heads, harelip, congenital absence of limbs, deficient or supernumerary fingers and toes, tails, extra breasts, and malformations of the internal organs. Abnormal forms and functions in the generative organs afford a large volume of curious material. Celebrated giants and dwarfs and other anomalies of size furnish material for a chapter, and there is a group of records of extraordinary longevity. Idiosyncrasies with regard to sound, vision, smell, taste, touch, foods, drugs, etc., endurance of fasting, power of contorting the body, endurance of pain, supernormal strength, etc., make up a long list. Many cases of recovery from unusual forms of injury to various parts of the body are recorded here, and there is much interesting material under the head of anomalous types of disease. The concluding chapter is a record of historic epidemics. A full general index and a bibliographic index are appended. The volume is illustrated with nearly three hundred figures and a considerable number of plates.

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* Röntgen Rays and Phenomena of the Anode and Cathode. By Edward P. Thompson and William A. Anthony. New York: D. Van Nostrand Co. Pp. 190, 8vo. Price, $1.50.

* Anomalies and Curiosities of Medicine. By George M. Gould, M. D., and Walter L. Pyle, M. D. Philadelphia: W. B. Saunders. Pp. 968, imperial 8vo. Price, cloth, $6; half morocco, $7.

An address on *The Railroad as an Element in Education*, delivered at the World's Fair in New Orleans in 1885, by Prof. *Alexander Hogg*, was widely circulated at the time, attracted much attention, and was noticed in the Monthly. It was an honest and forcible attempt to present the benefits the railroads have conferred upon society and the nation, and to antagonize the unreasoning populistic prejudice against them. It showed in a few words appealing directly to public intelligence that railroads have cheapened communication and transportation, have opened remote parts of the country, making them near and accessible, have removed the dangers of local famine, have contributed vastly to the national defense while removing the necessity of keeping large standing armies; and that in view of the services they render and of what is charged for like work abroad, their rates are extremely low. Further, the men who have acquired the most wealth through railroad management have also distinguished themselves by their benefactions to education and other contributions to public welfare. This address is now republished in a revised and enlarged form,* with additional chapters reviewing the development of the ten years subsequent to its original publication. Of these chapters one of the most important is the one on The Inception and History of Strikes, the methods of which are shown to be "wrong in principle and ruinous in practice."

The first volume of Prof. *W. J. Beal's Grasses of North America* † was published ten years ago, and was noticed by us in November, 1887. It was designed more particularly for farmers and students, and comprised chapters on the physiology, composition, selection, improving, and cultivation of grasses and clovers. The present volume supplements the former one to a certain extent, but in most respects it is an independent work. In it the grasses are classified and described, and each species is illustrated; and chapters are added on their geographical distribution, and also a bibliography. In most cases the generic characters closely follow those given by Bentham and Hooker in *Genera Plantarum*. Extracts are given regarding the writings of prominent authorities on the grasses; and also notes regarding the tribes and some of the genera. The author has been permitted to examine, during his studies for this work, the herbarium of Michigan Agricultural College, all the grasses in the herbaria of the University of Michigan and Harvard University (including the grasses of the late Dr. George Thurber), those of the Department of Agriculture at Washington, and those of Prof. F. L. Scribner; and, himself one of our leading botanists, has been assisted by Prof. L. H. Bailey and Prof. S. M. Tracy in the matter of geographical distribution, L. H. Dewey and A. A. Crozier. The work is a real addition to our botanical literature, filling as it does a department that has not before been completely occupied.

Mr. *Thomas D. Hawley*, of the Chicago bar, has prepared and published a new system of logic,* by which, he claims, reasoning can be carried on by an infallible process, even as the interest can be calculated upon a promissory note. The method consists in the repeated use of a few processes which are performed in a mechanical manner, and the results appear automatically. "Its tools are a few simple signs—namely, the capital letters of the alphabet to represent positive terms, the small letters to represent negative terms; the mathematical sign of equality, = for 'is'; a short prependicular mark, | for 'or,' and a square for the 'universe of discourse.' When a square is divided into a proper number of sections it is called a Reasoning Frame. By the use of the Reasoning Frame every proposition which can possibly be made with the letters used is set before us. We then eliminate every proposition which is inconsistent with the given proposition or state of facts. The uneliminated propositions which automatically remain in the Reasoning Frame will then give us every iota of truth which our data will yield." Aside from the signs and the device of the Reasoning Frame, the treatise does not appear to differ materially from other good treatises on the subject. The author's explanations are fairly clear. A complete index is an excellent feature.

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* The Railroad as an Element in Education. Revised and enlarged, with New Illustrations. (Special edition). By Prof. Alexander Hogg, Superintendent of Schools, Fort Worth, Texas. Louisville, Ky.: J. Morton & Co. Pp. 112.

† Grasses of North America. By W. J. Beal, Professor of Botany and Forestry in Michigan Agricultural College. In two volumes. Vol. II. New York: Henry Holt & Co. Pp. 706. Price, $5.

* Infallible Logic: A Visible and Automatic System of Reasoning. By Thomas D. Hawley, of the Chicago Bar. Lansing, Mich.: Robert Smith Printing Company. Pp. 659.

An unusual and fascinating biography is that of Sir Richard Burton,* the explorer and linguist, written by his niece. One does not know whether to wonder more at the extent of his travels or at his indefatigable industry in language study. The titles of sixty odd books are included in the list of his works, among them being an entire volume of the Royal Geographical Society, translations of Portuguese and Arabic, and several grammars of Hindu dialect. His journeyings were equally varied. We find him dwelling in the far East, in India and Arabia; later, crossing the Andes and pampas, in Brazil and Paraguay; now discovering the lakes in Central Africa, then investigating Utah, or exploring the mines of Iceland. Patient, persistent, undaunted by difficulties, he was admirably fitted by nature for the task of exploration. Had he been equally keen to read humankind, his local success among men might have been greater. Yet he may not have lacked discernment, but the will to be politic. Society is the rather to be arraigned, if, as we are told, "the habit of veracity sadly hindered him at times in his struggle with the world."

There is reason to believe that intellectual American women have somewhat surfeited themselves on the long-forbidden fruit of an education "just like the men's." They seem now to realize that the idea of a "woman's sphere" can have its dignity as well as its limitations, and that the possession of acute perception, clear reasoning ability, and high power of application can be shown in the wholesome and economical provisioning of a family and the efficient management of children and servants no less than in struggles with Greek roots and mathematical operations. The household arts are getting an increased share of attention both in women's clubs and in women's and coeducational colleges. A book now before us embodies a course of lectures on home management delivered in the University of Wisconsin.* These lectures give a general view of the field, presenting what might be called the theory of their subject, and using practical details merely by way of illustration or to give definiteness to the views set forth. After a preliminary chapter on the Statics and Dynamics of Household Economy, Mrs. Campbell considers first the house. These are some of the principles that she lays down as regards building:

> The plan of the house includes beforehand not only all that has been said as to location and its bearings, but also the settling of the cost and an intelligent idea of the special family needs. Here a woman's judgment is absolutely essential. It is the woman who lives chiefly in the house, and who, if common sense were brought to bear, would soon put an end to the type of thing the average builder offers her. Why should we perpetually go up and down when going sideways is so much easier? Why should we accept stupidly planned and inadequate closets or no closets at all, and kitchens in which everything is calculated to bring the greatest unhappiness to the greatest number? The utmost convenience in every inch of working space should be the law. The difference between a pantry opening close to the sink and one at the opposite end of the room may seem a small matter; but when it comes to walking across the room with every dish that is washed, the steps soon count as miles.

With regard to decoration, she urges the claims of the simple and elegant as against the flashy and trashy, and insists that the adornment of a useful article should never interfere with its use. Thus she says: "The pitcher that does not pour well can not be beautiful, though of gold. . . . The spider-legged table and its insect family of chairs—the things that creak when we sit down and tip over when we get up—these are not beautiful." Her treatment of domestic industries in general, the nutrition of the household, cleaning, and household service is in the same line. An excellent list of books for further study is added to each chapter. Lists of subjects for the use of women's clubs in studying household economy and information about clubs that have given some attention to this field are appended.

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* The True Life of Captain Sir Richard F. Burton. By Georgiana M. Stisted. New York: D. Appleton & Co. Pp. 419. Price, $2.

* Household Economics. By Helen Campbell. New York: G. P. Putnam's Sons. Pp. 286, 12mo. Price, $1.50.

This monograph * gives, in some eighty pages, a list of the published maps of Virginia. The first map, made in manuscript about the year 1585, bears the name of John With, a painter who was sent into the colonies by Walter Raleigh to paint the redskins and the other curiosities of the new-found country. Captain John Smith drew up his famous map in 1608. "In the boundary dispute between Virginia and Maryland in 1873 Smith's map was used as an authority, and prior to that it was the foundation upon which all the maps of Virginia were constructed." From 1608 onward the maps multiply, down to the last one, a railroad pocket guide published in 1893. Specimen reproductions, especially of the quaint older maps, would have enlivened this catalogue.

The greater part of the *Twelfth Annual Report of the Bureau of Labor Statistics of the State of Connecticut* is devoted to the practices prevailing in the various towns and cities of the State with regard to assessments for the purpose of taxation. The bureau has evidently investigated the matter thoroughly, and has discovered considerable foundation for the always current rumors as to inequalities. The information gathered, including suggestions from local assessors, is conveniently arranged, and besides its value within the State may well serve as a guide and model to officials of other States. The bureau has also collected the appraised values of over seven hundred probated estates, finding them to confirm closely the figures given by assessors. For purposes of comparison the tax laws of Connecticut, New York, and Massachusetts are here printed. Other investigations whose results are given in this volume are on the taxation of corporations, the condition of bakeshops, and the wages of factory hands.

A wonderful quantity of information concerning the various materials, processes, and applications of the photographic art is contained in the eleventh *American Annual of Photography* (Scovill & Adams Co., New York; paper 75, cents; cloth, $1). The aid that photography can give in surgery, mining, detecting forgery, etc., is told in special articles. Directions from which the amateur can use his prints to make a number of tasty and pleasing objects are another feature. Work with the X rays and color photography are two important recent developments that find place in the volume. There are also standard formulas, useful recipes, tables of chemicals, of capacities of lenses, of conjugate foci, of enlargement and reduction, of comparative exposures, etc., lists of photographic books and patents of the preceding year, and of American and foreign photographic societies. There are also a full almanac for 1897, postal and patent information, etc., while the large number of advertisements add no little value to the book. The volume contains over three hundred illustrations from photographs of pleasing and interesting subjects.

In his *First Year in German*, Mr. *I. Keller* has sought to avoid the defects and combine the advantages of the grammatical and "natural" methods of teaching the language. His method is simple, and includes practical exercises in which the grammatical features are explained as they occur. They consist of progressive reading lessons, translating from German to English and from English to German, with explanatory notes, oral and written exercises, and conversation exercises, with grammatical paradigms in the appendix. (American Book Company, $1.)

The *Report of the United States Commissioner of Fish and Fisheries for 1892–'93* is accompanied by three special reports of assistants in charge of especial inquiries. One of these deals with food fishes and the fishing grounds, and reports investigations into the physical and other conditions of the inland and coast waters of the United States. Another is occupied with the statistics and methods of the commercial fisheries, and the third details the operations of the commission in propagating and distributing food fishes. Following these is an extended account by William A. Wilcox of the Fisheries of the Pacific Coast, which have recently grown to importance, especially the catching of salmon for canning. The whaling and sealing of the Pacific are also important.

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* Virginia Cartography. A Bibliographical Description. By P. Lee Phillips. Smithsonian Miscellaneous Collections.

The volume includes also a report on the work of the steamer Albatross and a descriptive catalogue of the collections of the Albatross made in 1890 and 1891. A number of views and other plates illustrate the several papers. The volume for 1893–'94 contains reports on the same general inquiries as its predecessor, and among its special papers are a description of the exhibit of the commission at the World's Columbian Exposition, The Whitefishes of North America, The Fishes of the Missouri River Basin, A Review of the Foreign Fishery Trade of the United States, and a List of Publications of the Commission from its establishment.

Volume XXX, Part IV, of the Annals of the Harvard Observatory is devoted to a *Discussion of the Cloud Observations* made at the Blue Hill Meteorological Observatory, by *H. Helm Clayton*. Mr. Clayton begins with a historical sketch of cloud nomenclature which introduces his statement of the new systematic nomenclature adopted for the Blue Hill Observatory. The names devised at Blue Hill are designed to specify the form, altitude, and origin of the clouds. After considering briefly the methods of cloud formation and the relations of clouds to rainfall and to cyclones, Mr. Clayton gives an account of the annual and diurnal periods in the wind and the cloud movements that have been found from the Blue Hill observations. Other topics treated are the movements of the wind and clouds at different heights in cyclones and anticyclones, cirrus motions, and the velocity of storms. Some notes on the use of cloud observations in weather forecasting are added, and there is an appendix of tables and diagrams.

G. P. Putnam's Sons are now presenting to the public Volume II of *Books and their Makers during the Middle Ages*, by *George Haven Putnam*. In this new volume Mr. Putnam recounts the vicissitudes of two centuries' books and bookmakers—the trials and triumphs of those first ambitious, determined little companies of printer-publishers who, confronted ofttimes by the mighty odds of church and state, yet wielded so bravely and untiringly their new-found weapon that echoes of their resounding blows for truth and liberty still ring in the ears of men. Mr. Putnam dwells with emphasis and at some length on certain of the early printer-publishers of the Reformation period, selecting as representatives of that class the Kobergers in Nuremberg, Froben in Basel, the house of Plantin in Antwerp, Caxton in Bruges and in London, the Elzevirs in Leyden and Amsterdam, "and the famous families of the Estiennes or Stephani." The author modestly disclaims attempts at dramatic arrangement or presentation of his subjects, saying, as with regard to Luther, that he is "not concerned with Luther as a Reformer, as a fighter, or as a Christian hero, but simply with his work and his relations as an author"; nevertheless, there is much that is of deepest historic and dramatic interest to be found throughout the book. The volume is beautifully put together. With its plain, rich binding of dark red, its uncut linen pages, and clear type, it is a fitting specimen of what books and bookmakers have attained to in this day and age. (Price, $2.50.)

German Scientific Reading, compiled by *H. C. G. Brandt* and *W. C. Day* (Holt), embodies an excellent idea. Students of science taking up German, without caring to linger long over its literature, but wishing to acquire rapidly the facility of reading German scientific prose, will find here an adequate answer to their wants. The extracts, mostly by well-known German scientists, have been chosen for the simplicity of their diction and the value of the information they impart. Covering a wide range of sciences, they might prove as interesting reading to a class of general students as to specialists. Some twenty pages of descriptive prose, by those masters of style, Goethe and Humboldt, enliven the book by their literary quality. The notes are adequate, and the vocabulary "is intended to contain every word in the text, simple or compound, literary or technical." This collaboration of two specialists, professors respectively of German and of chemistry, has produced a Reader that should recommend itself to German teachers and classes in general.

Another portion of Weisbach's great work on mechanics, as revised by Hermann, dealing with *The Mechanics of Pumping Machinery* has been translated (Macmillans, $3.75). It is designed for the use of engineers and students of engineering; hence, while it gives some historical information about early forms of water elevators, it presents the mechanical side of even the simple bucket and sweep and the Dutch scoop. It is, of course, chiefly occupied with a technical presentation of the theory of reciprocating and rotary pumps, but gives a chapter to such additional water-raising machines as the hydraulic ram, ejectors, injectors, spiral pumps, and the pulsometer. The machines described are depicted in nearly two hundred engravings.

Miss *Sadie F. Price's Fern Collector's Handbook and Herbarium* (Holt, $2.25) is intended as an aid in the study and preservation of the ferns of the northern United States, including the district east of the Mississippi and north of North Carolina and Tennessee. It is a quarto volume, on the right-hand side of each page of which is given a full-size representation of some species of fern (seventy-two species being included), while the opposite page is left blank for the insertion of a pressed and dried specimen of the species. The letterpress consists of directions for preparing and fixing the specimens, the technical description of the order of ferns, and the list of illustrations or of species illustrated.

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Acloque, A. Les Insectes nuisibles (Injurious Insects). Paris: Félix Alcan. Pp. 192.

Alling-Aber, Mary R. An Experiment in Education. New York: Harper & Brothers.

Bell, Alexander Graham. The Mystic Oral School. Washington, D. C. Pp. 38.

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Clodd, Edward. Pioneers of Evolution. From Thales to Huxley. New York: D. Appleton & Co. Pp. 274, with portraits. $1.50.

Cuadrado, Dr. Gastón Alonso. Introduccion al Estudio de la Espectroscopia (Introduction to the Study of Spectroscopy). Havana. Pp. 39.

Chapman, Frank M. Bird-Life. A Guide to the Study of our Common Birds. New York: D. Appleton & Co. Pp. 269. $1.75.

Foster, Hon. John W. The Annexation of Hawaii. Washington. Pp. 16.

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Grimsley, G. P. Gypsum in Kansas. Washburn College, Topeka. Pp. 27, with 4 plates.

Grosse, Ernst. The Beginnings of Art. New York: D. Appleton & Co. Pp. 327, with 3 plates. $1.75.

Harris, William T. Art Education the True Industrial Education. Syracuse, N. Y.: C. W. Bardeen. Pp. 77. 50 cents.

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Thayer, Alexander Wheelock. The Hebrews in Egypt and their Exodus. Peoria: E. S. Willcox. Pp. 315. $1.25.

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Wiedemaun, Alfred. Religion of the Ancient Egyptians. New York: G. P. Putnam's Sons. Pp. 324.

Williams, George A. Topics and References in American History. With numerous Search Questions. Syracuse, N. Y.: C. W. Bardeen. Pp. 176. $1.

Fragments of Science.

Large Trees from the Coal Period.—The approach from the south to La Grange, Ala., is marked by the fine view into the valley of the Tennessee River, three or four hundred feet below, which it presents, and by the masses of sandstone lying around the village, where it has been precipitated from the cliffs above by the wearing away of the limestone under them. But the most interesting and remarkable feature of the locality, says Mr. Henry McCalley, in his geological report of the valley region, and the one for which La Grange will always be distinguished, is the profusion of the remains of fossil plants. Nowhere can one gain better ideas of the magnificence of the flora of the coal period than at this place. Trunks of *Lepidodendron*, two or three feet in diameter, lie buried and protruding from the *débris* of the sandstone. These trunks have in general preserved their form and are not at all compressed, whereby they show that they stood erect in the beds that inclosed them. Although stripped of their bark, the scars are plainly impressed on their surface. Two very fine specimens of these trunks are in the cabinet of the Geological Survey at the State University. One of them represents the lower part of the trunk, and has two large roots attached. The other has been used as a horse block, is about three feet in diameter and four feet high, and is remarkable for the impressions of calamites and other plants of which the sandstone composing it is full. The supposition is drawn from them that, in the process of petrifaction, the interior of the trunk was removed by decay or otherwise, leaving a hollow cylinder of the outer layers of the trunk, and that this hollow cylinder was filled up with sand and fragments of calamites and other coal plants, which subsequently hardened.

The Moki Indians and their Birds.—The Moki Indians are described, in Dr. E. A. Mearns's paper on the names of their birds, as having a superstititious regard for most living things, particularly as holding serpents in reverence and a number of birds as sacred, or as looking to them as representing their clans or secret religious orders. "Observers of Moki ceremonies have seen large wooden tablets in their *kivas* or ceremonial chambers painted with a green ground, ornamented with the rain prayer and some one of the countless Moki gods, and have remarked that the little bird in the clouds suggests the thunder bird of the plains Indians." Bourke remarked upon the constant appearance of feathers, chiefly those of the eagle and turkey. The Indians will not part, for any amount of money, with the wands of eagle feathers used for fanning living serpents at their snake dance, for fear of offending their bird deity. Sacrificial plumes of eagle down, attached to little sticks, are buried in the corners of the field at the opening of spring. The feathers of the parrot, brought up from Mexico, are treasured in the Pueblos, and will always be found, according to Bourke, "carefully preserved in peculiar wooden boxes, generally cylindrical in shape, made expressly for the purpose. With them is invariably associated the soft white down of the eagle. The Mokis have an especial veneration for the two species of eagle, which are kept by them in cages, and are fed largely on field mice and rabbits. Captain Bourke alludes to eagle feathers as common articles of commerce among these people, to which they attach a determinate value, and ascribes the high price placed upon them by all the sedentary Indians of Arizona and New Mexico to graver considerations than mercantile.

"Wild Indian Corn."—The question whether wild Indian corn is growing in America is raised in Garden and Forest by Robert P. Harris, who assumes that such a corn has been found in several regions of this continent, naturally reproducing itself, and that it has a character of growth that fits it for long preservation in a dry climate, although, if planted and cultivated for a few years, all the characteristics of wildness gradually disappear. "The cobs of wild maize are thin and hard, covered with lines of mushroom-shaped elevations, each having a wirelike pedicel growing from the top, attached to a glume inclosing a small pointed grain, or a flat grain smaller than any pop corn. These kernel husks overlap each other toward the point of the ear, like the shingles on the roof of a house. The imbrications are largest and longest at the butt of the ear, and gradually become less pronounced as they advance in distinct rows to the point. The individual glumes are from an inch to two inches long, and are much longer than this where the grains are not fertilized, particularly if the entire ear is of this character, as is proved by a specimen in my collection. Over these imbrications is the outside husk as we have it in all cultivated corns." Mr. Harris further says that Indian corn in its wild state has been found in Arizona, southern Texas, the valley of Mexico, and Central America. He has known Rocky Mountain corn a long period of time; it has very small ears. One of the professors of the University of Mexico has been experimenting with the wild corn of the valley, and has the engraving of a plant that grew to be about five feet high. Wild corn has also been grown by the Landreths, near Philadelphia, to whom it was sent from Arizona. Some found by Dr. Williams, of Houston, Texas, is a white flint of large size; but fifteen stalks produced only four ears, which grew on two of the stalks. The plant is a very vigorous grower, but it is not productive, and eight stalks grown in Texas did not bear a single ear. It may be doubted whether the evidence is as yet sufficient or is clear enough to establish that these specimens are really wild corn and not corn that has escaped from cultivation—the more so, because Indian corn with glumes to each kernel is not rare.

Dr. Yersin and Plague Virus.—Nature, of February 18th, brings an interesting account of Dr. Yersin's discovery of the plague virus and its antitoxine, during the epidemic at Hong Kong in the spring of 1894. His attention being attracted to the extraordinary number of dead rats lying about in the squalid Chinese quarters of the city, he examined them, and discovered immense numbers of a short bacillus, that could be easily stained and cultivated in the usual manner. He found the same bacilli in different organs of plague patients. Noticing quantities of dead flies in the room where he carried on his post-mortem examinations, he investigated this symptom, and established by experiment that these insects also were infected, and assisted in the spread of the disease. He forwarded cultures of his bacillus to the Pasteur Institute at Paris. Experiments made on rabbits and guinea pigs proved that the dead bacilli, if injected in sufficient number, are deadly; smaller quantities, however, act as a vaccine, and protect the subject against stronger inoculation. Experiments with larger animals, such as horses, were equally successful. "That the most remarkable therapeutic value attaches to anti-plague serum, as now elaborated at the Pasteur Institute in Paris, is shown by the success which has recently followed its application in undoubted cases of plague at Amoy, by Yersin, now director of a Pasteur Institute at Wha-Trang in Annam.

Marriage of the Dead.—Among the many curious practices that Marco Polo came across in his travels in the far East, the Tartar custom of marrying the dead deserves notice. He says: "If any man have a daughter who dies before marriage, and another man have had a son also die before marriage, the parents of the two arrange a grand wedding between the dead lad and lass, and marry them they do, making a regular contract! And when the contract papers are made out they put them in the fire, in order that the parties in the other world may know the fact, and so look on each other as man and wife. And the parents thenceforward consider themselves sib to each other just as if their children had lived and married. Whatever may be agreed on between the parties as dowry, those who have to pay it cause to be painted on pieces of paper, and then put these in the fire, saying that in that way the dead person will get all the real articles in the other world." This custom is also noted by other writers, even as late as the beginning of the eighteenth century. It is said to have been adopted by Jenghis Khan, for political reasons, and is named in his Yasa, published in 1205 A. D.

The Three "R's" of Prehistoric Man.—M. Ed. Piette has published an interesting discovery in *L'Anthropologie*, (vol. vii, 1896, p. 385). He found in a cave at Mas-d'Azil, in the department of Ariège, a quantity of pebbles, rounded, oblong, and flattened, such as are taken from river beds. They were variously painted with peroxide of iron; some had their whole surface colored, and others again showed a border around the margin, or were dotted and striped in different designs. Crosses, serpentine patterns, and even trees could be traced out. M. Piette thinks that according to these devices the pebbles stand for numerals, symbols, pictographic signs, and alphabetic characters. He gives loose rein to his fancy in interpreting them, especially the last named. He reaches the startling conclusion that some are probably syllabic signs, used for inscriptions or in building up words. Twenty-five colored plates accompany the memoir, and give food for speculation on these cabalistic memorials of a bygone era.

Animals on the March.—Among the animals that take long journeys in great numbers are the springbok, the American bison, the musk ox, and, in smaller bodies, wild horses and the antelopes of the steppes. Journeying mostly over the plains, they nearly always move in a wide front, a way of marching that gives an equal chance to all in browsing. Some species of birds also migrate on foot. The guinea fowls always go in single file, a favorite mode of travel in Central Africa, where paths have to be cut through the dense scrub or impassable forests. The European wild geese are the champion walkers among birds. Belying the stigma attached to their name, they show much forethought in their pedestrian expeditions, which are undertaken either to accompany their young, or during the molting season. Unhasting, yet unresting, they march ahead in column, often ten geese abreast, careful not to jostle their neighbors, with head erect in the air. From time to time the leaders give the signal to halt and feed, and then to "fall in" again and continue on the road. Abroad, before the days of railways, dealers in poultry, making use of this marching power, often saved expense by letting the geese transport themselves. Droves numbering nine thousand have walked over the road from Suffolk to London. At Antwerp not long ago large flocks were seen marching up the plank to a steamer bound for Harwich, and then gravely descending to the lower deck to range themselves in an inclosure, quite unwittingly going to their own death. Animals on the march rarely suffer from hunger. The quadrupeds, being all vegetarians, go toward the regions of their food supply. Birds "feed up" for a time before their migration, and during their sea trips live on the fat stored away on their bodies. Fish on the march are the most leisurely of creatures. Floating along with hardly any efforts of propulsion, and constantly surrounded by their food supply, they appear the favored among travelers.

Maori Tattooing.—Major-General Robley, who has studied the tattooing, or "moko," of the Maoris, represents that the custom is no longer practiced among the men. King Tawhaio, two years ago, carried to his grave "one of the last really fine specimens of moko." Apparently every chief who was decorated had a special design, and a variety of beautiful patterns in arabesque arose. They certainly show, the Athenæum says, that a variety of designs can be derived from the adaptation of scroll work to the outlines of the human face, and exhibit much technical skill in dealing with an intractable material. The work was done with a chisel made of a sea bird's wing bone or a shark's tooth, a fragment of stone or hard wood, ground down to a fine edge, which was driven into the skin by a smart tap, causing a deep cut and much effusion of blood, which was wiped away with the flattened end of the mallet or with a wad of flax. After contact with Europeans, iron chisels were sometimes used. The association of a special design with the individual tattooed had the advantage of serving as a means of identification, and this led to the curious result that Maori chiefs attached as their signature to deeds and other documents a facsimile of the moko tattooed on their faces. It is said that even an enemy would respect a head conspicuous for a beautiful moko.

The Caucasus as a Pleasure Resort.—The Caucasus Mountains are held up by Sir Douglas Freshfield, who knows them well, as a desirable pleasure resort and especially well adapted to a horseback excursion. Provisions are plenty, and the configuration of the region lends itself to a riding tour. The Caucasus is suited for general travelers, for lovers of the picturesque, whether or not they are painters, as well as for peak-hunters. If above its snow level its granite crests, its icy hollows, its hanging glaciers, and fluted snow slopes impress the intruder with a sublimity beyond that of the Alps, its high valleys have attractions for men of the most various pursuits and hobbies. The physical geographer will find materials for a contrast between the features of the Caucasus and those of better-known ranges. For example, why do so many Caucasian glaciers fail to fill their valleys and leave a pleasant dell between the moraines and the mountain sides? . . . I am not competent and do not attempt to act as a guide to the Caucasus as a whole. My 'Central Caucasus' bears to the whole region something of the same proportion that the Central Alps, between the Little St. Bernard and the Bernina Pass, do to the Alpine chain. It is the most important section, but it is only a section. On one side, to the east, lie the wild highlands of Daghestan, the scene of Schamyl's resistance, with their high plateaus cleft by narrow ravines, their hill fortresses, and at least three high glacier groups. On the west stretch the great forests and granite crests which hem the tributaries of the Kuban, a region probably of extraordinary beauty. The glaciers of one of its groups have just been mapped for the first time by the Russian surveyors. They are otherwise wholly unexplored. The only travelers to penetrate these fortresses have been Dr. Radde, who has, in *Petermann's Mittheilungen*, published an account of his journeys, a stray botanist or two, and those indefatigable pursuers of wild animals, Mr. and Mrs. Littledale, who have hunted the aurochs in the wilds of the Zelentshuk."

Historical Wampum Belts.—One of the last papers of the late Horatio Hale was recently communicated to the Anthropological Institute, London, by Prof. E. B. Tylor, and related to four historical Huron wampum belts. To this Prof. Tylor added some remarks of his own, which were illustrated by the exhibition of specimens and lantern slides. It was explained how the Iroquois belt might be distinguished from others by the occurrence of diagonal bands of beads, contrasting in color with those forming the ground. These diagonals are derived from the diagonal rafters of the peculiar "long houses" of the Iroquois. Other well-known conventional symbols represent hearts, houses, lands, the "peace path," etc. One of the belts exhibited was itself a historical record of some interest, as it depicted a proposal of conversion to Christianity made by the early Jesuit missionaries to the Indians, the message being effected by working into a wampum belt a symbolic group consisting of the lamb, the dove, and several crosses. The investigations made by Mr. Hale seem to show that the "Penn Belt," which is now in New England, is not a record of the famous scene depicted by Benjamin West, but of a more obscure treaty concluded with Iroquois chiefs. The intrinsic evidence afforded by the belt convinced Mr. Hale that it was made by Iroquois. In this way anthropology has been able to correct history. The speaker also illustrated the use of wampum belts as records in modern times, exemplified by the annual meeting of chiefs, at which all the belts are carefully gone over, in order that events of tribal importance may be kept green.

Elephants in a Lumber Yard.—No work done by elephants perhaps requires at once greater intelligence and strength on their part than that of those which are used in unloading and piling up timber in the lumber yards of Burmah. The most important of these lumber yards, at Rangoon, receives the timber that comes down from the immense forests of the Irrawaddy, with the great logs lashed together into huge rafts. The workmen cut the cords, and the task of the elephants begins. Plunging without hesitation into the muddy waters of the river, they go at once toward the logs. Each animal selects a stick, pushes it with his trunk to the shore, picks it up, and lands it, all that his driver has to do being to indicate what log he wishes taken. Twelve of these animals, according to M. Charles Marsillon, eleven males and one female, work constantly in the yard. The female is the most intelligent of all of them. At the sawmill she places the piece to be cut before the saw. She uses her trunk as a hand; takes the boards away as they are made, and piles them symmetrically in the drying heap. As the sawdust accumulates and threatens to cover everything up, she blows it away with her powerful nostrils, keeping the place cleared so that the work can go on unobstructed. When the dinner bell rings, nothing—neither threats nor caresses—can keep her in the yard, industriously as she has worked till then. She seems to see to it too that her companions also stop. The elephants return to work immediately the signal is given. Sometimes one of them comes upon a stick that is too heavy for him to handle alone; and then one of his companions, perceiving his trouble, will come to his assistance. It seems to be one of the easiest things in the world for these animals to arrange and straighten the pile of logs whenever it begins to take a crooked or uneven shape. If they are not able to do this with their trunks, they use their tusks until the pile is got into order. They work willingly and with interest, call for help when they need it, and respond to one another's appeals.

Substitutes for Glass in Germany.—An interesting account of glass substitutes is given in a recent copy of the Journal of the Society of Arts. Tectorium, which is used in Germany as a substitute for glass, is a sheet of tough, insoluble gum—said to be bichromated gelatin—about one sixteenth of an inch thick, overlying on both sides a web of galvanized iron or steel wire, the meshes of which are generally about one eighth of an inch square. It feels and smells similar to the oiled silk that is used in surgery. It is lighter than glass, tough, pliant, and practically indestructible by exposure to rain, wind, hail, or any shock or blow which does not pierce or break the wire web. It may be bent into any desired form, and when punctured can be easily repaired. Its translucency is about the same as that of opal glass, with a greenish amber color, which fades gradually to white on exposure to the sun; so that while arresting the direct rays of sunshine, it transmits a soft, modulated light, which is said to be well adapted to hothouses and conservatories. It is a poor conductor of heat and cold. Its surface is well adapted for printing in oil colors, and is thus valuable for decorative purposes. The objections against it are that it is inflammable, and is apt to soften in warm weather. For hot-beds and forcing houses the Germans have another substitute glass called *Fensterpappe*, which is a tough, strong manilla paper which is soaked in boiled linseed oil until it becomes translucent and impervious to water. This paper costs wholesale in Germany about 19*s*. 6*d*. per roll one hundred metres in length by one metre in width. It admits sufficient light for growing plants, does not require to be shaded in hot sunshine, is light, durable, and practically secure against breakage, and is said to be a hundred times cheaper than glass. There is a new product recently patented and placed on the German market, called *Hornglas*. It is very similar to tectorium in appearance and properties, the two advantages claimed for it being greater transparency and less liability of softening under a hot sun.

Animal Traits.—Among the birds in the "Zoo" at the Hague not commonly found in menageries is the "rhinoceros bird," or "buffel pikker," from the Transvaal, which is described by the natural-history writer in the London Spectator as a bird of remarkable habits and unusual plumage. Small flocks of these birds accompany most of the large antelopes, the buffaloes, and the rhinoceroses in South Africa, and run all over the creatures' bodies, picking off flies and insects. When an enemy approaches, the "buffel pikkers" sit in line with heads raised on the back of the animal they are attending, like sparrows on a roof ridge, and signal the alarm. The plumage is close, uniform, and compact, giving the bird an appearance of being covered with polished satin rather than with feathers. The monkeys have an outdoor house, floored with loose sand, exactly suitable for a playground agreeing with their natural habits, which communicates with their cages by holes through the wall. The holes fairly represent the rock crevices in the animals' native hills, and the monkeys slip through them to the sand, which they can turn over in search of insects, as they do at home. When thirsty, they go to the stone water troughs set in the runs and drink, standing on all fours, sucking up the water as a horse does. The elephant in this Zoo has had to sacrifice his dignity and come down to playing tricks. It earns small coins by blowing a mouth organ with its trunk and grinding a coffee mill. It plays dominoes "with laborious care," lifting each piece from the table and depositing it next that placed by the keeper, with a very audible noise.

Canon Gore on Evolution and the Fall.—In a lecture recently delivered at Sheffield, England, Canon Gore examines the contradictions between the Christian doctrine of the sudden fall and the scientific doctrine of the gradual rise of man. "According to the theory of evolution," he said, "man began his career at the bottom, emerging from purely animal life, and slowly struggled upward to his present level of attainment. According to the Christian doctrine, on the contrary, he was created perfect, and then subsequently fell into sin and accompanying misery." Intellectually, however, the Bible does not represent primitive man as perfect. His faculties at the beginning were in a childish state, and his mastery over the arts and sciences was a gradual acquirement. But it maintains that man from the first was endowed with a perfected moral feeling for right and wrong, and that his one act of disobedience not only affected his own life but also tainted with lawlessness his after-comers. Canon Gore maintains that according to the third chapter of Genesis man was at first in direct relation to a divine will, and could have followed the path of development pointed out to him. He thereby would have spiritualized not only his own nature, but by the simple law of heredity would have fathered a race moving in an altogether higher moral sphere.

Marsupials and their Skins.—The marsupials (the pouch-bearing animals) of Australia, the opossums, wombats, kangaroos, and wallabies (smaller kangaroos), are among the fur-bearing animals killed in the largest numbers. They have been looked upon as pests, and a premium put upon their heads by the Government, so that now they are exterminated in many parts of the country. Their skins are not at all estimated at their proper value, being mostly made up into cheap rugs, or used for sole leather and japanned boots, or the hair is scraped off and manufactured into felt. Yet they would be a valuable addition to the European fur trade, were the animals not constantly killed and the skins shipped to England in the summer, when the fur is almost useless. The coat, especially of the kangaroo, is close and soft like plush, with beautiful tints of French gray, warm red, orange, and rose color. The famous "boxing kangaroo" attracted a good deal of attention some three years ago. It earned an immense sum of money, sometimes given as £20,000. It had not received any special training; its keeper simply took advantage of the fact that a tame kangaroo who knows its master will always "box" when invited to do so, putting up his short forearms to ward off any imaginary blows. This kangaroo set the fashion for the sport, for the animals at once were sought after for sparring exhibitions, and for a time all the kangaroos in Europe outside of the menageries nightly drew crowds to their pugilistic feats. Kangaroos easily adapt themselves to the European climate; they thrive well in the zoölogical gardens, and have even been successfully kept on private estates in England. Their graceful poses and their soft, beautifully tinted coats make them objects of general attraction.

Roadside Orchards.—The experiment of planting fruit trees along the sides of public highways has been tried with satisfactory results in several German states and in Austria, and the products of the plantations have been the means of adding considerably to the revenues of the Governments thereof. In Saxony the profit derived by the state from that source during fourteen years is estimated at about four hundred thousand dollars. Planting of forest trees by the sides of the roads has been abandoned in Würtemberg, and the plantation and care of fruit trees are regulated by law. The trees are placed in the care of the abutting proprietor under the supervision of the highway inspector. In Bavaria and the Palatinate each road man is duplicated by a horticulturist, for whose qualification special instruction is provided, and who has to pass a competitive examination. In some regions the lines of the railroads are also planted, and in others the minor roads and even private roads. The system has made the most rapid progress and reached the highest development in the grand duchy of Luxemburg, where special classes are held every year, under a professor in the agricultural school, for teaching the inspectors and road hands the theoretical and practical elements of the orchardist's art.

The Dalai Lama.—Mr. St. George R. Littledale, who traveled in Tibet in 1894, learned from an interpreter that the Dalai Lama then reigning was about twenty years old, and was to come of age in the succeeding November. The Rajah of Lhasa, who was acting as regent, would then lose his power and retire into private life. The last two Dalai Lamas had died between the ages of eighteen and twenty, which seemed to be a peculiarly fatal period in the lives of these potentates. The present regent had held office for forty years, and might perhaps have given interesting details of the last illnesses of two of his sovereigns. The Dalai Lama, however often the dignitary may be reincarnated, never really dies; the incarnation descends to some infant, whom it is the business of the lama priesthood to discover. When found, he is brought to Lhasa, surrounded by crowds of lamas, who educate him for the position he is so seldom allowed to fill. The Dalai Lama of Mr. Littledale's time was discovered as a baby at Thokopo, five days from Lhasa. The Teshu Lama at Shigatze was a boy of twelve or thirteen, who during his minority was under the tutelage of Lhasa. When a Tibetan lama dies, they carry the body to a mountain, cut it to pieces, and the vultures do the rest. The Dalai Lama is embalmed, and gold and jewels are inserted into his face. The three great incarnations—the Dalai Lama, the Teshu Lama, and the Taranath Lama—are all equally holy, and their sedan chairs, when in Lhasa, are each carried by eight bearers, while the two Chinese mandarins are allowed only four bearers apiece.

Quick Growth of a Myth.—A pertinent illustration of the way myths and legends may grow and expand is illustrated by the story of Alexander (the Great), of which Mr. E. A. Wallis Budge has published the Syriac and Ethiopic versions. No instance of the development of fables, says the Athenæum's review of one of these publications, can be more instructive; for we start from a real man, living in the clear light of history, whose acts were chronicled at the time by respectable historians. Nevertheless, so transcendent was his genius, so marvelous were his deeds, that almost immediately after his death—probably, indeed, during his life—popular imagination lays hold of him, adds adventures, miracles, words of wisdom, wonders of all sorts, and so transforms him into a colossal mythical figure, which looms through the mists of fable, as fantastic as Jack the Giant Killer. The diffusion of the Alexander stories is probably the widest ever attained by any heroic legend. "There are versions of them stretching through all the middle ages in time, and reaching in space from the Malay Peninsula to Ireland; and, as every nation has desired a popular or home edition, we can even yet find either complete or partial texts in at least wenty-three languages." Dr. Budge describes the process of amplification of the myth as starting with the distortion and enlargement of the first tolerably accurate description, and going on till, "when the hero has become a mere memory, his name will be made in each country that adopts the story a peg on which to hang legends and myths."

MINOR PARAGRAPHS.

A bow and arrows taken from an Egyptian tomb of the twenty-sixth dynasty and exhibited to the London Anthropological Institute differ in a very marked manner from the native Egyptian bows, and are believed to be of Assyrian origin. The differences are very evident when a comparison is made with the typical Egyptian archer's equipment which was found in the same tomb. The bow is elaborately built up of several materials, and is therefore to be classed with the "composite bows," being allied to the modern Asiatic bows comprised under this term. The materials of which it is composed are wood (two kinds), dense black horn, sinews of animals, birch bark, and glue. The birch bark, which completely enveloped the bow in a continuous sheath, would of itself proclaim the implement to be a foreign and northern introduction into Egypt, and the whole character of the weapon bears out this supposition.

It is related in the Life of Brian Houghton Hodgson, the first great collector of Buddhist manuscripts, that while seeking for books in Nepaul he was surprised at the wide diffusion of literature among the masses. He attributed it to the knowledge of printing which the Tibetans had derived, probably, from China. "But the universal use they make of it," he said, "is a merit of their own. The poorest fellow who visits this valley is seldom without his religious tract, and from every part of his dress dangle charms made up in slight cases, whose interior exhibits the neatest workmanship." The universal use of writing, as shown by the abundance of manuscripts, was hardly less noticeable than the wide diffusion of printed books. The writing of many of these ancient manuscripts exhibits fine specimens of very graceful penmanship; and they owe their preservation, the author of the memoir says, to having been guarded in their wrappings of silks as sacred heirlooms.

The well-known germicidal qualities of oxygen have led to its recent application in the treatment of surgical wounds. Examinations of the bacteriological conditions of affected parts before and after treatment, says Mr. George Stoker in a recent British Medical Journal, show that oxygen has a selective action in reference to micro-organisms. Whatever may be the connection between the organisms and the state of a wound or sore, it seems to be established that when in a wound treated by oxygen healing is arrested or retarded, there is always a corresponding decrease of favorable and increase of unfavorable micro-organisms. If the strength of the oxygen bath be increased when this condition arises, the character of the micro-organisms from the wound is entirely reversed. A long and varied experience of the oxygen treatment has led Mr. Stoker to conclude that the method heals in less time than any other form of treatment, allays pain, stops foul discharges, forms a healthy new skin, and is far more economical than any other form of treatment, both as regards suffering and money.

The scientific merits of archæology were well set forth in an address made by Mr. W. M. Flinders Petrie at the recent annual meeting of the Egypt Exploration Fund. The science had made great advances, one indication of which was the unexpectedly large circulation of books on the subject. There had, too, been a more scientific spirit shown in its treatment, and problems were approached simply with the desire to learn the truth, and not with the expectation of proving something. The time had indeed come when archæology was regarded as one of the elements of a liberal education. It was now fully recognized that it was not a mere fad or dilettant amusement, but had thrown great light on the history of the human mind.

NOTES.

At the meeting of the Council of the American Association for the Advancement of Science, held at Washington April 21st, Prof. Theodore Gill, as senior vice-president, succeeded under the constitution to the position of acting president, *vice* E. D. Cope, deceased. Prof. Gill was requested by vote of the Council to prepare an obituary notice of President Cope, and to deliver it before the association at the Detroit meeting in lieu of the ordinary presidential address by the retiring president, and he undertook to do so. Prof. Leland O. Howard was nominated vice-president for the Section of Zoölogy (Section F), *vice* G. Brown Goode, deceased.

The observations of Mr. Percival Lowell at Flagstaff, Arizona, in which he assumes to have had vastly more distinct views of the planet's disk than were ever before obtained, indicate that the period of the diurnal rotation of Venus is identical with that of its revolution round the sun. Hence it has one side constantly turned toward the sun and the other constantly averted from it—everlasting burning heat on one side and never-intermitted cold on the other.

A proposition is under consideration in the English scientific societies for the establishment, in commemoration of the sixtieth year of her Majesty's reign, of a Victoria Research Fund, to be administered by representatives of the various scientific societies for the encouragement of research in all branches of science.

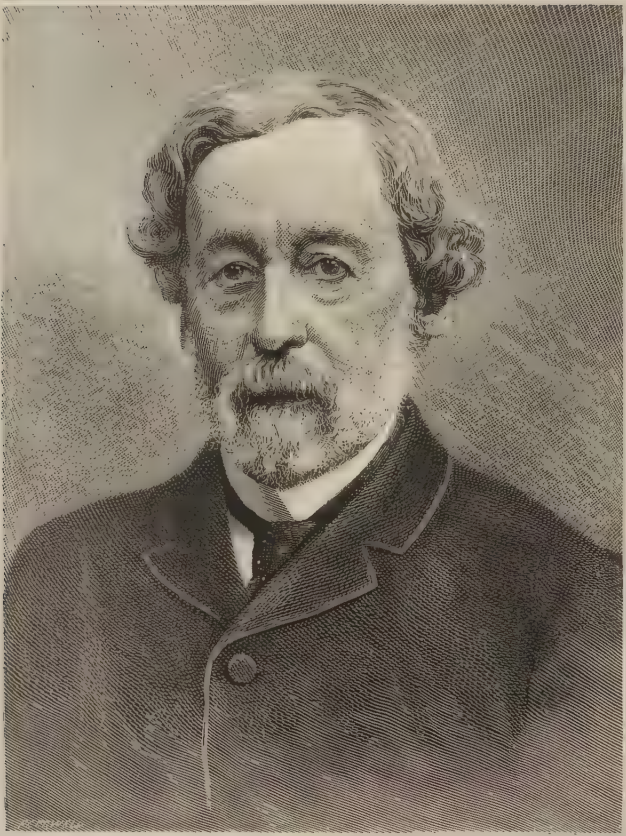
The people of Detroit are working earnestly in preparation to give the American Association a cordial welcome and hospitable entertainment at its coming meeting there. A general interest seems to be taken in the matter, as was exemplified by the recent attendance of an audience of twenty-five hundred persons upon a lecture by the secretary of the association, Prof. Putnam. The press is co-operating with the citizens' committee in making the interest lively, and the effect is apparent in the subscription lists. While it is already reasonably certain that all who go to the meeting will be well and amply taken care of, the people hope that their invitation will be responded to by a large attendance of Americans and Englishmen and others interested in science.

The work in anthropology in the University of Chicago, for the present associated with that in sociology, includes courses in general anthropology, general ethnology, prehistoric archæology (European and American, in alternation), ethnology (the American race), physical anthropology (elementary and laboratory courses), laboratory work, Mexican ethnography and archæology, ethnology of Japan, the pueblos of New Mexico, and lectures by Dr. W. I. Thomas on folk psychology, primitive art, and Slavic ethnology. Several important collections are on deposit in the university, representing Mexican archæology, the cliff dwellings and cave house of Utah, the Aleutian Islands and Eskimos, Japan, and the collection of the International Folklore Association.

The Blue Hill Meteorological Observatory, Massachusetts, was established in 1885 by Mr. A. Lawrence Rotch, and is maintained by him at his own expense. By arrangement it co-operates with the observatory of Harvard College, and its observations are published, partly at Mr. Rotch's expense, in the annals of that institution. Since the land surrounding the observatory has been taken for a public park, a lease for ninety-nine years has been taken of the ground it needs, which will enable its work to be continued under invariable conditions of exposure.

The French journal *L'Anthropologie* publishes an account of the discovery of the Moi race of tailed men by M. Paul d'Enjoy in Indo-China. M. d'Enjoy saw only one of the men, the rest of the village having run away, but he conversed with this one and saw where the people lived. The man was found in a large tree, into which he had climbed for honey. His climbing was like that of a monkey, and in coming down he applied his sole to the bark. The tail is not the only peculiarity of this race, for their ankle bones are extraordinarily developed, so as to resemble the spurs of roosters. The Mois use poisoned barbed arrows, and are treated by the natives around them as brutes.

Baron Constantin Ettingshausen has died at Graz, aged seventy-one. Beginning his scientific career as a doctor, he later on devoted himself to the study of botany and paleontology. He arranged the paleontological collections in the British Museum (natural history). He wrote many papers for the Proceedings of the Royal Society, and for the journals of other learned bodies.



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APPLETONS' POPULAR SCIENCE MONTHLY.

JULY, 1897.

THE RACIAL GEOGRAPHY OF EUROPE.

A SOCIOLOGICAL STUDY.

(*Lowell Institute Lectures, 1896.*)

By WILLIAM Z. RIPLEY, Ph. D.,
ASSISTANT PROFESSOR OF SOCIOLOGY, MASSACHUSETTS INSTITUTE OF TECHNOLOGY; LECTURER IN ANTHROPO-GEOGRAPHY AT COLUMBIA UNIVERSITY.

VI.—FRANCE—THE TEUTON AND THE CELT.

SEVERAL reasons combine to make France the most interesting country of Europe from the anthropological point of view. More is known of it in detail than of any other part of the continent save Italy. Its surface presents the greatest diversity of climate, soil, and fertility. Its population, consequently, is exposed to the most varied influences of environment. It alone among the other countries of central Europe is neither cis- nor trans-alpine. It is open to invasion from all sides alike. Lying on the extreme west coast of Europe, it is a place of last resort for all the westward-driven peoples of the Old World. All these causes combine to render its population the most heterogeneous to be found on the continent. It comprises all three of the great ethnic types described in our last paper, while most countries are content with two. Nay more, it still includes a goodly living representation of a prehistoric race which has disappeared almost everywhere else in Europe.*

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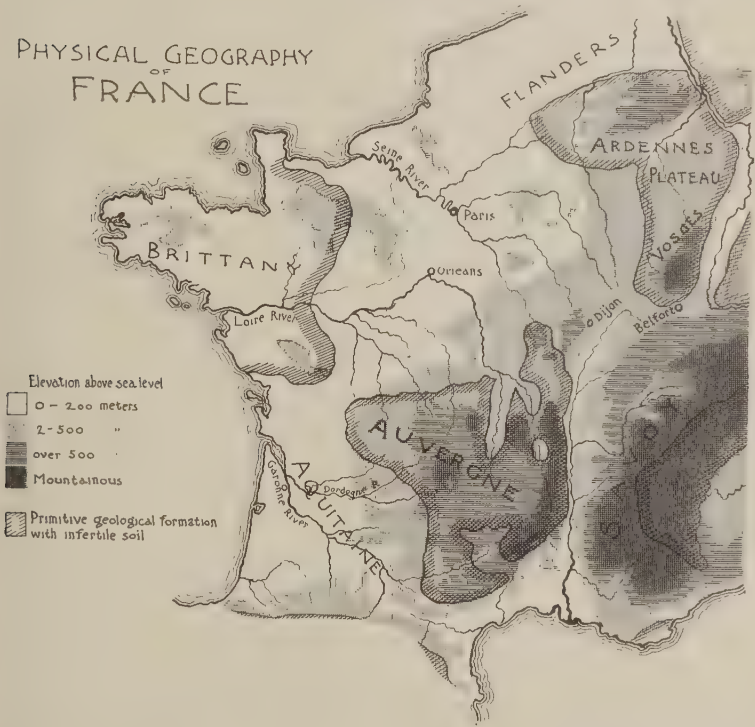
* It would be ungracious not to acknowledge publicly my indebtedness to two of the foremost authorities upon the population of France—Dr. R. Collignon, of the École Supérieure de Guerre at Paris, and Prof. G. V. de Lapouge, of the University of Rennes in Brittany. Invaluable assistance in the preparation of this and the following paper has been rendered by each. No request, even the most exacting, has failed of a generous response at their hands.—W. Z. R.

Thirty years ago lay observers began to note differences in central France between the people of the mountains and of the plains. As early as 1868 Durand de Gros noted that in Aveyron, one of the southern departments lying along the border of a mountainous area, the populations of the region thereabout were strongly differentiated. On the calcareous plains the people were taller, of light complexion, with blue or blue-grayish eyes and having fine teeth. In the upland areas, of a granitic formation, the people were stunted, dark in complexion, with very poor teeth. These groups used distinct dialects. The peasants differed in temperament. One was as lively as the other was morose. One was progressive, the other was backward in culture, suspicious of innovations. This same observer noted that the cattle of the two regions were unlike. On the infertile soils they were smaller and leaner, differing in bodily proportions as well. He naturally, therefore, offered the same explanation for the differences of both men and cattle—namely, that they were due to the influences of environment. He asserted that the geology of the districts had affected the quality of the food and its quantity at the same time, thereby affecting both animal and human life. When this theory was advanced, even the fact that such differences existed was scouted as impossible, to say nothing of the explanation of them. As late as 1889 I found a German geologist, in ignorance of the modern advance of anthropology, strongly impressed by these same contrasts of population, and likewise ascribing them to the direct influence of environment as did the earlier discoverer. These differences, then, surely exist even to the unpracticed eye. We must account for them; but we do it in another way. The various types of population are an outcome of their physical environment. This has, however, worked not directly but in a roundabout way. It has set in motion a species of social or racial selection, now operative over most of Europe. This process it is our province to describe in this paper.

Before we proceed to study the French people, we must cast an eye over the geographical features of the country. These are depicted in the accompanying map, in which the deeper tints show the location of the regions of elevation above the sea level. At the same time the cross-hatched lines mark the areas within which the physical environment is unpropitious, at least as far as agriculture—the mainstay of economic life until recent times—is concerned.

A glance is sufficient to convince us that France is not everywhere a garden. Two north and south axes of fertility divide it into three or four areas of isolation. These differ in degree in a way which illustrates the action of social forces with great clearness. Within these two axes of fertility lie two thirds of all the cities of France with a population of fifty thousand or over. The major one extends from Flanders at the north to Bordeaux in the southwest. Shaped like an hourglass, it is broadened about Paris and in Aquitaine, being pinched at the waist between Auvergne and Brittany. The seventy-five miles of open country which lie between Paris and Orleans have rightly been termed by Kohl "the Mesopotamia of France." This district is not only surpassingly fertile; it is the strategic center of the country as well. At this point the elbow of the Loire comes nearest to the Seine in all its course. An invader possessed of this vantage ground would have nearly all of France that was worth having at his feet. If the Huns under Attila, coming from the east in 451, had captured Orleans as Clovis did with his Frankish host at a later time, the whole southwest of France would have been laid open to them. The Saracens, approaching from the opposite direction along this axis, had they been victorious at Tours, could in the same way have swarmed over all the north and the east, and the upper Rhone Valley would have been within reach. The Normans in their turn, coming from the north-

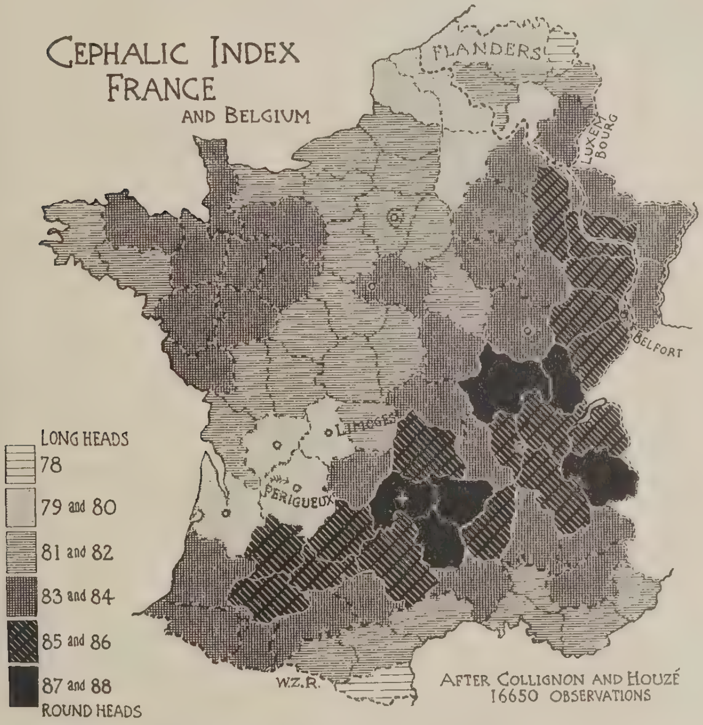


west, must needs take Orleans before they could enter the heart of the country. Finally, it was for the same reason that the English fought for the same city in 1429, and the Germans took it twice, in 1815 and again in 1870. This district, then, between Paris and Orleans, is the key to the geographical situation, because it lies at the middle point of this backbone of fertility from north to south.

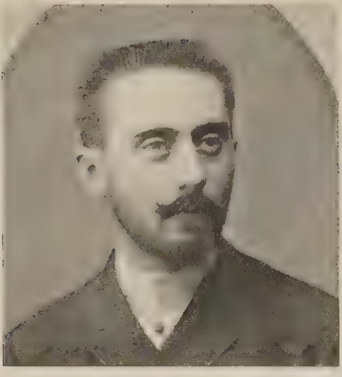
The second axis, lying along the river Rhone, is of somewhat less importance as a center of population because of its extreme narrowness. Yet it is a highway of migration between the north and the south of Europe, skirting the Alps; and it is easily accessible to the people of the Seine basin by the low plateau of Langres near the city of Dijon. This renders it the main artery of communication from Paris to the Mediterranean. Down its course Teutonic blood has flowed. The culture of the south has spread into northern Europe in the contrary direction. Such is the normal exchange between the two climates in human history, the world over. The great fertility of the Rhone axis, moreover, is in strong contrast to the character of the country upon either side. Judged by its population, it merits the important position we have here assigned to it.

These two axes of fertility divide France, as we have said, into three areas which exhibit the phenomena of social isolation in different degrees. East of the Rhone lies Savoy, exceedingly mountainous, with a rigorous Alpine climate, and of a geological formation yielding with difficulty to cultivation. This region combines two safeguards against ethnic invasion. In the first place, it is not economically attractive; for the colonist is unmoved by those charms which appeal to the tourist to-day. We reiterate, the movement of peoples is dependent upon the immediate prosperity of the country for them. It matters not whether the invading hosts be colonists, coming for permanent settlement, or barbarians in search of booty; the result is the same in either case. Savoy, therefore, has seldom attracted the foreigner. It could not offer him a livelihood if he came. In the second place, whenever threatened with invasion, the defense of the country was easy. Permanent conquest is impossible in so mountainous a district. Combining both of these safeguards in an extreme degree, Savoy, therefore, offers some of the most remarkable examples of social individuality in all France.

The second area of isolation lies between our two north and south axes of fertility—that is to say, between the Rhone on the east and the Garonne on the southwest. It centers in the ancient province of Auvergne, known geographically as the *Massif Centrale.* This comprises only a little less than two thirds of France south of Dijon. In reality it is an outpost of the Alps cut off from Savoy by the narrow strip of the Rhone Valley. Much of it is a plateau elevated above two thousand feet, rising into mountains which touch three thousand feet in altitude. Its climate is unpropitious; its soil is sterile; impossible for the vine, and in general even for wheat. Rye or barley alone can be here successfully raised. At the present time this region is almost entirely given over to grazing. It has vast possibilities for the extractive arts; but those meant nothing until the present century. For all these reasons Auvergne presents a second degree of isolation. It lacks all economic attractiveness; but it is not rugged enough in general to be inaccessible or completely defensible as is Savoy.



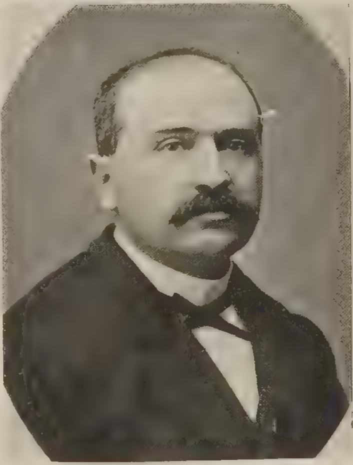
Brittany, or Armorica, the third area of isolation, is perhaps somewhat less unattractive economically than Auvergne. It is certainly less rugged. Extending in as far as the cities of Angiers and Alençon, it is saved from the extreme infertility of its primitive rock formation by the moisture of its climate. Neither volcanic, as are many parts of Auvergne, nor elevated—seldom rising above fourteen hundred feet—it corresponds to our own



TEUTONIC TYPE. Blond.
Index, 77.

as well. A cross in the core of Auvergne in each case; the Rhine shown in the northeast; the location of Paris, Lyons, Belfort, etc., will enable the reader to keep them all in line at once.

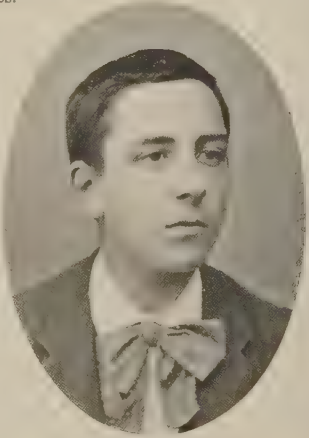
Earlier in our work we have seen that the several physical traits which betoken race vary considerably in their power of resistance to environmental influences. This resistant power is greatest in the head form; less so in the pigmentation and stature. As we are now studying races, let us turn to our most competent witness first. It will be remembered, from a preceding paper, that we measure the proportions of



ALPINE TYPE. Hautes Alpes.
Neutral. Index, 96.

New England. For the farmer, it is more suited to the cultivation of religious propensities than to products of a more material kind. It is the least capable of defense of the three areas of isolation; but it redeems its reputation by its peninsular position. It is off the main line. It is its remoteness from the pathways of invasion by land which has been its ethnic salvation.

In order to show the effect which this varied environment, above described, has exerted upon the racial character of the French people, we have arranged a series of three parallel maps in the following pages, showing the exact distribution of the main physical traits. For purposes of comparison certain cities are located upon them all alike, including even the map of physical geography



MEDITERRANEAN TYPE.
Brunette. Index, 76.

the head by expressing the breadth in percentage of the length from front to back.* This is known as the cephalic index. We have also seen that a high index—that is, a broad head—is the most permanent characteristic of the so-called Alpine race of central Europe. This type is bounded on the north by the long-headed and blond Teutons, on the south by a similarly long-headed Mediterranean stock, which is, however, markedly brunette. It is with these three racial types that we have mainly to do in this paper. Passing over all technicalities, our map of cephalic index shows the location of the Alpine racial type by its darker tints; while, in proportion as the shades become lighter, the prevalency of long and narrow heads increases.

The significance of these differences in head form to the eye is manifested by the three portraits at hand. The northern long-headed blond type, with its oval face and narrow chin, is not unlike the Mediterranean one in respect of its cranial conformation. This particular Teutonic type is slightly misleading, from the mode of dressing the hair, which tends to exaggerate the width at the forehead. The Alpine populations of central France are exemplified by rather an extreme type in our portrait, in which the head is almost globular, while the face is correspondingly round. Such extremes are rare. They indicate the tendency, however, with great distinctness. The contrast between the middle type and either extreme is well marked. Even with differences but half as great as those between our portrait types, it is no wonder that Durand and other early observers should have insisted that they were real and not the product of imagination. They may have erred in their explanations, although not in their facts.

Recalling the physical geography of the country, as we have described it, the most patent feature of our map of cephalic index is a continuous belt of long-headedness, which extends from Flanders to Bordeaux on the southwest. It covers what we have termed the main axis of fertility of France. A second strip of long-headed population fringes the fertile Mediterranean coast, with a tendency to spread up the Rhone Valley. In fact, these two areas of long-headed populations show a disposition to unite south of Lyons in a narrow light strip. This divides the dark-colored areas of Alpine people into two wings. One of these centers in the Alpine highlands, running up to the north; the other, in Auvergne, extends away toward the Spanish frontier. At the present time let us note that this intrusive strip of long heads cutting the Alpine belt in two follows the exact course of the canal which has long united the head waters of the Loire with the Rhone. It is an old channel of communication between Marseilles and Orleans. Foreigners, immigrating along this highway, are the cause of the phenomenon beyond question.

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* It should not fail of notice that these maps are constructed from averages for each department as a unit. These last are merely administrative districts, entirely arbitrary in outline, and entirely in dissonance with the topography of the country. The wonder is that, in view of this, the facts should still shine out so clearly. Thus all the Rhone departments lie half up among the mountains on the east. Their averages are therefore representative neither of the mountains nor the valleys. Between Dijon and Lyons the departments completely span the narrow valley, entirely obliterating its local peculiarities.

The long-headed populations therefore seem to follow the open country and the river valleys. The Alpine broad-headed type, on the other hand, is always and everywhere aggregated in the areas of isolation. Its relative purity, moreover, varies in proportion to the degree of such isolation enjoyed or suffered. In Savoy and Auvergne it is quite unmixed; in Brittany only a few vestiges of it remain. And yet these few remnants are strictly confined within the inhospitable granitic areas, so that the boundaries of the two correspond very closely. The spoken Celtic tongue has also lingered here in Brittany for peculiar reasons, which we shall soon discuss. The main one is the isolation of the district, which has sheltered the Alpine race in the same way. For it is now beyond question that the Breton, the Auvergnat, and the Savoyard are all descendants of the same stock. In nearly every case the Alpine race is found distributed, as Dr. Collignon says, "by a mechanism, so to speak, necessary, and which by the fatal law of the orographic condition of the soil ought to be as it is." In the unattractive or inaccessible areas the broad-headedness centers almost exclusively; in the open, fertile plains the cephalic index falls as regularly as the elevation. So closely is this law followed that Dr. Collignon affirms of the central plateau that wherever one meets an important river easily ascended, the cephalic index becomes lower and brachycephaly diminishes.

The two-hundred-metre line of elevation above the sea seems most nearly to correspond to the division line between types. This contour on our geographical map is the boundary between the white and first shaded areas. Compare this map with that of the cephalic index, following round the edge of the Paris basin, and note the similarity in this respect. There is but one break in the correspondence along the eastern side. This exception it is which really proves the law. It is so typical that it will repay us to stop a moment and examine. We have to do, just south of Paris, with that long tongue of dark tint, that is of relative broad-headedness, which reaches away over toward Brittany. It nearly cuts the main axis of Teutonic racial traits (light tinted) in two. This is the department of Loiret, whose capital is Orleans. It is divided from its Alpine base of supplies by the long-headed department of Yonne on the east. This latter district lies on the direct route over to Dijon and the Rhone Valley. Teutonic peoples have here penetrated toward the southeast, following the path of least resistance as always. Why, you will ask, is the Loiret about Orleans so much less Teutonic in type? The answer would appear were the country mapped in detail. The great forest of Orleans, a bit still being left at Fontainebleau, used to cover this little upland between the Seine and the Loire, east of Orleans. It was even until recently so thinly settled that it was known as the *Gatinais*, or wilderness. Its insular position is for this reason not at all strange. The Teutons have simply passed it by on either side. Those who did not go up the Seine and Yonne followed the course of the Loire. Here, then, is a parting of the ways down either side of Auvergne.

Another one of the best local examples illustrating this law that the Alpine stock is segregated in areas of isolation and of economic disfavor is offered by the Morvan. This "*mauvais pays*" is a peninsula of the Auvergne plateau, a little southwest of the city of Dijon. It is shown on our geographical map. It is a little bit of wild and rugged country, about forty miles long and half as wide, which rises abruptly out of the fertile plains of Burgundy. Its mountains, which rise three thousand feet, are heavily forested. The soil is sterile and largely volcanic in character; even the common grains are cultivated with difficulty. The limit of cultivation, even for potatoes or rye, is reached by tilling the soil one year in seven. This little region contains at the present time a population of about thirty-five thousand—less to-day than fifty years ago. Until the middle of the century there was not even a passable road through it. It affords, therefore, an exceedingly good illustration of the result of geographical isolation in minute detail. Its population is as strongly contrasted with that of the plains round about as is its topography. The people, untouched by foreign influence to a considerable extent, have intermarried, so that the blood has been kept quite pure. The region is socially interesting as one of the few places in all France where the

TYPES IN THE MORVAN.

birth rate long resisted the depressing influences of civilization. For years it has been converted into a veritable foundling asylum for the city of Paris. Its mothers have cared for innumerable waifs besides their own offspring. This isolated people is strongly Alpine, as our portraits show, the boy on the right being a peculiarly good type; the other one has a strain of Teutonic narrow-headedness from all appearances. Beyond a doubt here is another little spot in which the Alpine race has been able to persist by reason of isolation alone.*

The law which holds true for most of France, then, is that the Alpine stock is confined to the areas of isolation and economic unattractiveness. A patent exception to this appears in Burgundy—the fertile plains of the Saone, lying south of Dijon. A strongly marked area of broad-headedness cuts straight across the Saone Valley at this point. A most desirable country is strongly held by a broad-headed stock, although it is very close to the Teutonic immigration route up along the Rhine. Here we have a striking example of the reversion of a people to its early type after a complete military conquest. It serves as an apt illustration of the impotency of a conquering tribe to exterminate the original population. The Burgundians, as we know, belonged to a blond and tall race of Teutonic lineage, who came to the country from the north in considerable numbers in the fifth century. The Romans welcomed them in Gaul, forcing the people to grant them one half of their houses, two thirds of their cultivated land, and a third of their slaves. For about a thousand years this district of Burgundy took its rule more or less from the Teutonic invaders: and yet to-day it has completely reverted to its primitive type of population. It is even more French than the Auvergnats themselves. The common people have virtually exterminated every trace of their conquerors. Even their great height (shown on our stature map), for which the Burgundians have long been celebrated, is probably more to be ascribed to the material prosperity of the district than to a Teutonic strain. One factor contributing to the result we observe is that the fertile country of the Saone Valley is open to constant immigration from Switzerland and the surrounding mountains. The Rhine has drawn off the Teutons in another direction, and political hatreds have discouraged immigration from the north-east. The result has been that the Alpine type has been strongly re-enforced from nearly every side, while Teutonic elements have been gradually eliminated.

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* It should be noted that this relation does not appear upon our map of head form, because this represents merely the averages for whole departments. The Morvan happens to lie just at the meeting point of three of these, so that its influence upon the map is entirely scattered. Most interesting details are given in Mémoires de la Société d'Anthropologie, Series 3, I, 1894, fasc. 2.

Another and perhaps even more potent explanation for this localization of the Alpine type in Burgundy also lies at hand. This fertile plain is the last rallying point of a people repressed both from the north and the south. The general rule, as Canon Taylor puts it, is that the "hills contain the ethnological sweepings of the plains." This holds good only until such time as the hills themselves become saturated with population, if I may mix figures of speech. Applying this principle to the present case, it appears as if the original Alpine stock in Burgundy had been encroached upon from two sides. The Teutons have overflowed from the north; the Mediterranean stock has pressed up the Rhone Valley. Before these two the broad-headed Alpine type has, as usual, yielded step by step, until at last it has become resistant, not by reason of any geographical isolation or advantage, but merely because of its density and mass. It has been squeezed into a compact body of broad-headedness, and has persisted in that form to the present time. It has rested here, because no further refuge existed. It is dammed up in just the same way that the restless American borderers have at last settled in force in Kansas. Being in the main discouraged from further westward movement, they have at last taken root. In this way a primitive population may conceivably preserve its ethnic purity, entirely apart from geographical areas of isolation as such.

What is the meaning of this remarkable differentiation of population? Why should the Alpine racial type be so hard favored in respect of its habitat? Is it because prosperity tends to make the head narrow; or, in other words, because the physical environment exerts a direct influence upon the shape of the cranium? Were the people of France once completely homogeneous until differentiated by outward circumstances? There is absolutely no proof of it. Nevertheless, the coincidence remains to be explained. It holds good in every part of Europe that we have examined—in Switzerland, the Tyrol, the Black Forest—and now here in great detail for all France. Two theories offer a possible and competent explanation for it all. One is geographical, the other social.

The first theory accounting for the sharp differences of population between the favorable and unpropitious sections of Europe is that the population in the uplands, in the nooks and corners, represents an older race, which has been eroded by the modern immigration of a new people. In other words, the Alpine Celts once occupied the land much more exclusively; they were the primitive possessors of the soil. From the north have come the Teutonic tribes, from the south the Mediterranean peoples; in France, just as in the Tyrol, as we have pointed out in a preceding paper. The phenomenon, according to this theory, is merely one of ethnic stratification.

A second explanation, much more far reaching in its prognosis, is, as we have said, sociological. The phenomenon is the outcome of a process of social selection, which rests upon racial or physical differences of temperament. This theory is advanced by Ammon of Baden, and his disciple Lapouge in France, in two very remarkable recent books.* Briefly stated, it is this: In some undefined way the long-headed type of head form is generally associatad with an energetic, adventurous temperament, which impels the individual to migrate in search of greater economic opportunities. The men thus physically endowed are more apt to go forth to the great cities, to the places where advancement in the scale of living is possible. The result is a constant social selection, which draws this type upward and onward, the broad-headed one being left in greater purity thereby in the isolated regions. Those who advocate this view do not make it necessarily a matter of racial selection alone. It is more fundamental. It concerns all races and all types within races. This is too comprehensive a topic to be discussed in this place; we shall hope to deal with it later. Personally, I think that it may be, and indeed is, due to a great process of *racial* rather than purely *social* selection. I do not think it yet proved to be other than this. The Alpine stock is more primitive, deeper seated in the land; the Teutonic race has come in afterward, overflowing toward the south, where life offers greater attractions for invasion. In so doing it has repelled or exterminated the Alpine type, either by forcible conquest or by intermixture, which racially leads to the same goal.†

Before we proceed further let us examine the other physical traits a moment. The map of the distribution of brunetteness shows these several Alpine areas of isolation far less distinctly than the map of the cephalic index. It points to the disturbing influence of climate or of other environment. If the law conducing to blondness in mountainous areas of infertility were to hold true here as it appears to do elsewhere, this factor alone would obscure relations. Many of the populations of the Alpine areas should, on racial grounds, be darker than the Teutonic ones; yet, being economically disfavored, on the other hand, they tend toward blondness. The two influences of race and environment are here in opposition to the manifest blurring of all sharp racial lines and divisions. Despite this disturbing influence, the Auvergnat area appears as a great wedge of pigmentation penetrating the center of France on the south. This is somewhat broken up on the northern edge, because of the recent immigration of a considerable mining population into this district which has come from other parts of the country. The Rhone Valley appears as a route of migration of blondness toward the south. Little more than these general features can be gathered from the map of color, except that the progressive brunetteness as we advance toward the south is everywhere in evidence. Were we to examine the several parts of France in detail we should find competent explanations for many features which appear as anomalous—as, for example, the extreme blondness upon the southwest coast of Brittany.

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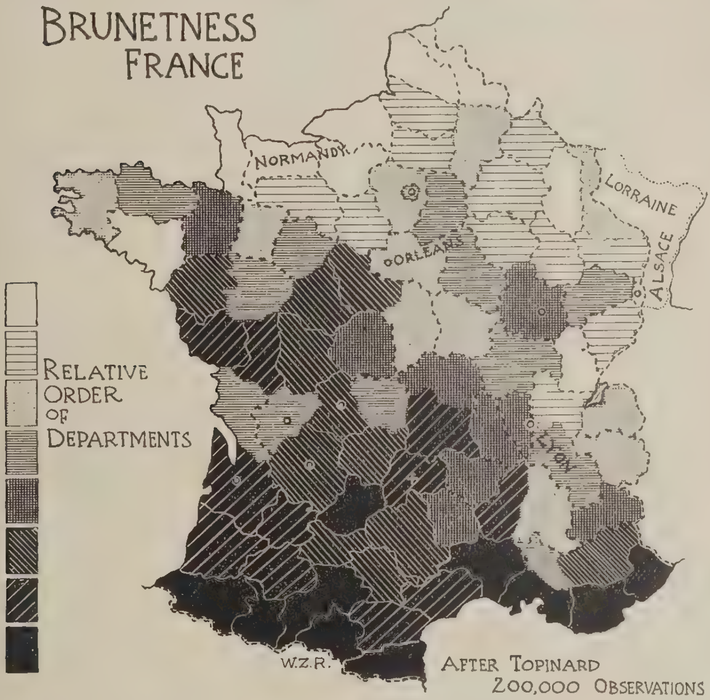
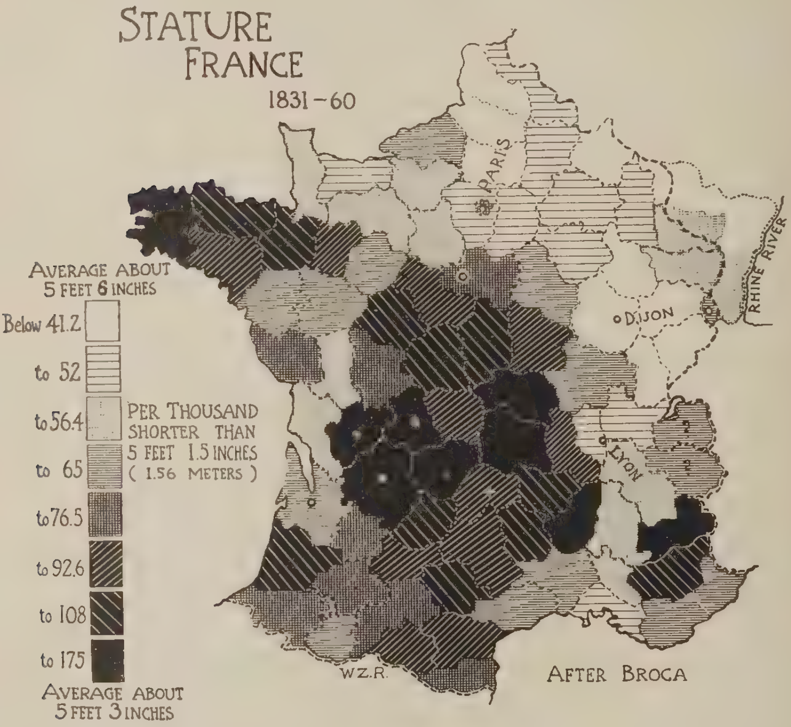
* Natürliche Auslese beim Menschen, Jena, 1893. Les Sélections Sociales, Paris, 1896.

† For an exceedingly interesting discussion of the action of economic and social forces in France, *vide* Auvergne, by T. E. Cliffe-Leslie in Fortnightly Review, xvi, p. 736 *seq.*

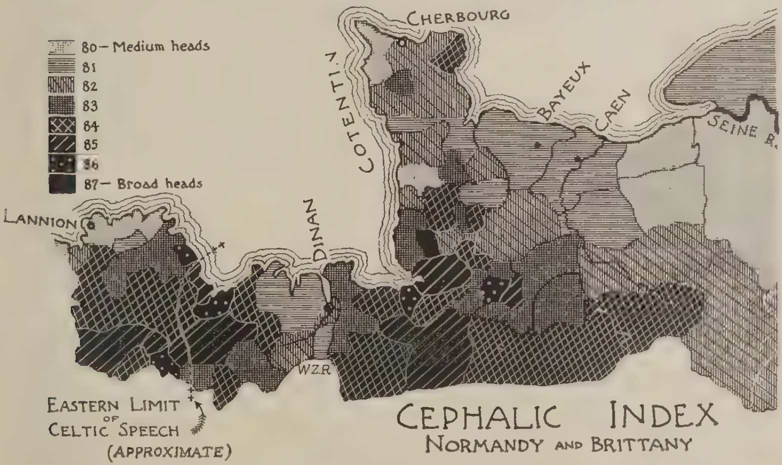


The map of stature still preserves evidence of the threefold division of the short Alpine people into Savoyards, Auvergnats, and Bretons. It demonstrates in great clearness the influence of the Rhone Valley in the production of tall stature. In this case the process is cumulative, for the fertile valley productive of increased bodily height is at the same time a highroad of immigration for the Teutonic race, which always carries a tall stature wherever it goes. The main axis of fertility from Paris to Bordeaux does not appear, for two reasons. The area about Limoges and Perigueux (see map of cephalic index on page 293), with the shortest population of all, is the seat of a prehistoric people which we shall describe in our next paper; and north of it toward Orleans local causes with which we have not time to deal here have been operative.


STATURE
FRANCE
1831–60
AVERAGE ABOUT 5 FEET 6 INCHES
Below 41.2
to 52
to 56.4
to 65
to 76.5
to 92.6
to 108
to 175
PER THOUSAND SHORTER THAN 5 FEET 1.5 INCHES (1.56 METERS)
AVERAGE ABOUT 5 FEET 3 INCHES
PARIS
DIJON
LYON
RHINE RIVER
W.Z.R.
AFTER BROCA

Brittany and *Normandy* are two of the most interesting regions in Europe to the traveler and the artist. The pleasing landscapes and the quaint customs all serve to awaken interest. To the anthropologist as well the whole district possesses a marked individuality of its own. Within it lie the two racial extremes of the French people—the old and the new—closely in contact with one another. Attention was first attracted to the region because of the persistence of the Celtic spoken language, now vanished everywhere else on the mainland of Europe—quite extinct, save as it clings for dear life to the outskirts of the British Isles. Here again, we find an ethnic struggle in process, which has been going on for centuries, unsuspected by the statesmen who were building a nation upon these shifting sands of race. This struggle depends, as elsewhere in France, upon the topography of the country. The case is so peculiar, however, that it will repay us to consider it a little more in detail.

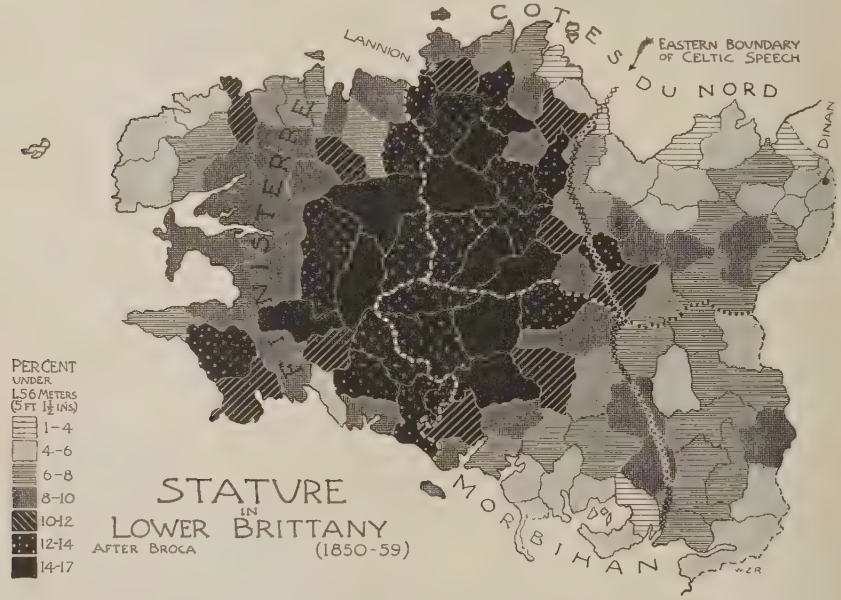
The anthropological fate of Brittany, this last of our three main areas of isolation, depends largely upon its peninsular form. Its frontage of seacoast and its many harbors have rendered it peculiarly liable to invasion from the sea; while at the same time it has been protected on the east by its remoteness from the economic and political centers and highways of France. This coincidence and not a greater purity of blood has preserved its Celtic speech. Since the foreigners have necessarily touched at separate points along its coast, concerted attack upon the language has been rendered impossible. This fact of invasion from the sea has divided its people not into the men of the mountain distinct from those of the plain—a differentiation of population, by the way, as old as the reforms of Solon and Cleisthenes. The contrast has arisen between the seacoast and the interior. The people of the inland villages contain a goodly proportion of the Alpine stock, although, as our maps show, it is more attenuated than in either Savoy or Auvergne. To the eye this Alpine lineage appears in a roundness of the face, a concave nose in profile, and broad nostrils. Along the coast intermixture has narrowed the heads, lightened the complexion, and, perhaps more than all, increased the stature. For an example of these contrasts our maps will



CEPHALIC INDEX
NORMANDY AND BRITTANY

serve as an illustration. We have already made use of one in a preceding paper. It is reproduced for purposes of comparison.

In view of the nature of these physical changes induced by ethnic crossing along the seacoast, we must look to the Teutonic race for the lineage of the invaders. They must, on the whole, have been light and long-headed. History, in this case, comes to our aid. The Saxon pirates skirted the whole coast around to the mouth of the Loire. In fact, they were so much in evidence that part of it was known to the old geographers as the *litus Saxonicum.* The largest colony which has left permanent traces of its invasion in the character of its present population, although Cæsar assured us that he exterminated it utterly, is located in Morbihan. This department on the south coast of the peninsula, as our map of coloration of all France shows, is one of the blondest in all France. Its capital, Vannes, derives its name from the Venetes, whose confederation occupied this area. Both Strabo and Diodorus of Sicily asserted that these people belonged to the Belgæ (Teutonic stock), although modern historians of Gaul seem inclined to deny it. Our anthropological evidence is all upon the side of the ancient geographers.


COTES DU NORD
LANNION
EASTERN BOUNDARY OF CELTIC SPEECH
DINAN
FINISTERE
MORBIHAN
PER CENT UNDER 1.56 METERS (5 FT 1½ INS)
1-4
4-6
6-8
8-10
10-12
12-14
14-17
STATURE IN LOWER BRITTANY
AFTER BROCA
(1850-59)
W.Z.R.

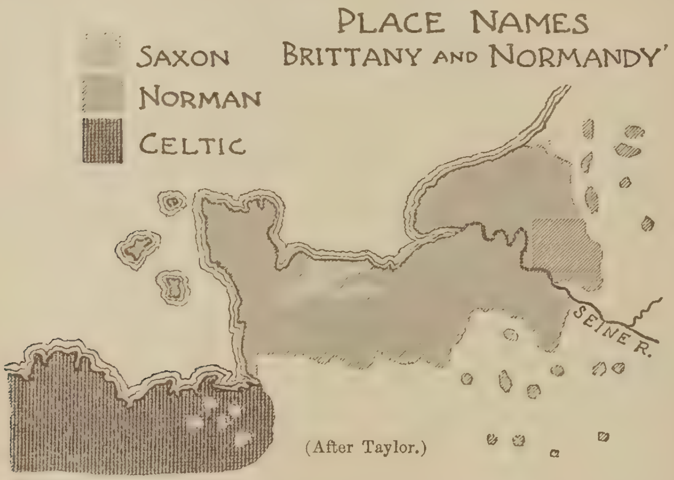
From a different source, although due indirectly to these same Teutonic barbarians, are derived the physical characteristics of the people in the north of Brittany, near Dinan, in the valley of the Rance. Its location appears upon both of our maps of Brittany.

This little district is very distinct from the surrounding country. The landscape also is peculiar in many respects. The cottages are like the English, with hedgerows between the several plots of ground. All these outward features corroborate the anthropological testimony that this was a main settlement of the people who came over from Cornwall in the fifth century, ousted by the Anglo-Saxons. They, in fact, gave the name Brittany to the whole district. They spoke the Celtic language in all probability, but were absolutely distinct in race. They seem to have been largely Teutonic. The Saxons soon followed up the path they laid open, so that the characteristics of the present population are probably combined of all three elements. At all events, to-day the people are taller, lighter, narrower-nosed, and longer-headed than their neighbors. A similar spot of narrow-headedness appears upon our map at Lannion. The people here are, however, of dark complexion, short in stature, characterized by broad and rather flat noses. Here is probably an example of a still greater persistence in ethnic traits than about Dinan, for the facts indicate that here at Lannion, antedating even the Alpine race, is a bit of the prehistoric population which we promise to identify in the next paper.

Normandy is to-day one of the blondest parts of France. It is distinctly Teutonic in the head form of its people. In fact, the contrast between Normandy and Brittany is one of the sharpest to be found in all France. The map of cephalic index on page 293 shows the regularly increasing long-headedness as we approach the mouth of the Seine. In the Norman departments from thirty to thirty-five per cent of the hair color is dark; in the adjoining department of Cotes-du-Nord, in Brittany, the proportion of dark hair rises from forty to sixty, and in some cases even to seventy-five per cent. In stature the contrast is not quite as sharp, although the people of the seacoast appear to be distinctly taller than those far inland. The ordinary observer will be able to detect differences in the facial features. The Norman nose is high and thin; the nose of the Breton is broader, opening at the nostrils. In many minor details the differences are no less marked.

Normandy, on the whole, is an example of a complete ethnic conquest. At the same time, while a new population has come, the French language has remained unaffected, with the exception of a spot near the city of Bayeux, where the Saxons and Normans together combined to introduce a bit of the Teutonic tongue. This conquest of Normandy has taken place within historic times. It is probably part and parcel of the same movement which Teutonized the British Isles; for it appears that the Normans were the only Teutonic invaders who can historically be traced to this region. Wherever they left the country untouched, the population approaches the Alpine type, being darker, broader-headed, and shorter in stature. This indicates that the tribes, such as the Caletes (the city of Caux), the Lexovii (Lisieux), and the Baiocasses (Bayeux) in Cæsar's time were probably of this latter type; in other words, that the district was Alpine in population until the Normans came with Rollo in the tenth century. The Romans appear to have allowed the Saxons to settle at places along the seacoast, but they had never penetrated deeply into the interior.

The correspondence between the map of Norman place names and that of cephalic index is sufficiently close to attest to the value of each. One of the common features of the Teutonic village names is "ville," from "weiler," meaning an abode, and not from "villa," of Romance origin. This suffix appears, for example, in Hacon*ville*, or in a corrupted form in Hardi*villiers*. Another common ending of place names is *bœuf*, as in Marbœuf. Dr. Collignon has traced out a considerable number of such place names of Norman origin, all of which point to the Cotentin—that distinct peninsula which juts out into the English Channel—as a center of Norman dispersion. Certain it is that Cherbourg, at its extremity, shows the Norman element at its maximum purity. Probably this was a favorite base of supplies, protected by its isolation and in close proximity to the island of Jersey, which the Normans also held. The Saxon colony near Caen was a factor also which determined this location. The extension of the Normans to the west seems to have been stopped by the human dike set up by the English and Saxons about Dinan, and by "Norman Switzerland," the hilly region just east of it. Follow the



(After Taylor.)

similarity between the boundary of long and narrow heads on our map of cephalic index of Brittany, and the cross-hatched lines and tints on the map of physical geography of France on page 291. Note how it cuts across diagonally from northwest to southeast, parallel to the course of the Seine. Here the economic attraction in favor of the invasion of Brittany ceased, and at the same time the displaced natives found a defensible position. Prevented from extension in this direction, the Normans henceforth turned toward the Seine, where, in fact, their influence is most apparent at the present time. Paris, the Mecca of all invaders, toled them away, and Brittany was saved.

FORECASTING THE PROGRESS OF INVENTION.

By WILLIAM BAXTER, Jr.

THE great progress made during the last fifty years in the domain of science and invention has aroused a very general desire among intelligent people to know what the future has in store, and in many cases the desire has become so strong as to develop prophetic tendencies. Whenever a banquet is given in commemoration of some scientific event, or upon the anniversary of some ancient and honorable society, the orator of the evening is sure to dwell at considerable length upon the great discoveries that are still to come. By contrasting the extraordinary advances made during the last century with the comparatively limited progress of all previous time, and by showing that the rate of advancement has been continually increasing during the latter period, he arrives at the conclusion that in the years to come development will increase in a compound ratio, and the discoveries will become so numerous and so great as to dwarf into insignificance all that has been accomplished up to the present time.

Writers who dwell upon these glorious achievements of mankind in modern times follow the same vein, and make equally extravagant predictions as to the future. If these writers and orators would stop when they reach this point in their meditations they would be wise, since it is a self-evident fact that progress in science and invention has been increasing very rapidly during the last fifty or sixty years, and certainly there is no reason to suppose that we have reached the end, and that henceforth development will be very slow; but at this point the spirit of prophecy seizes them, and they proceed to describe the wonders yet unseen. It is here that they almost invariably fail. They would not be satisfied if they assumed that future progress would be along the lines of possible development—that would be too commonplace and altogether out of keeping with the ideal of the greatness of the future achievements of mankind. They must necessarily assume that what is brought forth hereafter will be so far in advance of what we now know of as to be revolutionary in its character, and so much so, in fact, as to consign to the scrap heap the most perfect devices of the present time. Some of the means by which these results are to be attained are not capable of accomplishing such wonders; others, while of great theoretical possibilities, are surrounded by certain practical difficulties so well understood at the present time that we can almost with certainty say that they will never realize the dreams that are based upon them. The remainder are problems that can be solved to-day, and would be if it were not for the fact that it is by no means certain that their solution would be of any practical value. The improbability of ever realizing a substantial gain by the solution of many of the problems upon which prophecies as to the wonders of the future are based is fully appreciated by many of those who have given the subject careful consideration; but those who dream of the revolutionary character of future invention never take note of such things.

Nearly all those who succumb to the fascination of meditating upon the changes that may be wrought by inventive genius in days to come follow the same line of thought. The problems upon the solution of which their fancy paints its pictures are always the same, although some contemplate the whole category, while others only dwell upon a portion thereof. These problems are aërial navigation, the development of electric energy direct from coal or some other equally cheap substance, and the utilization of the various forces of Nature, such as solar heat, tide and wave motion, and wind currents. Of these, aërial navigation is supposed to be by far the most important, obtaining electricity direct from coal and the others following along in the order in which they are given above.

As to the utilization of solar heat, tides, wave motion, and wind currents, it can be truthfully said that they could be utilized at the present time if it were considered profitable to do so. The energy of wind currents, as every one knows, is made available on a very extensive scale, but always in small units, and this fact alone shows that it can not compete with the steam engine, which, according to the prophets, it is sure to supersede. The energy of tides and wave motion is also utilized to some extent, and solar engines have been made from time to time.

It can not be said that these unlimited sources of energy are not brought into the service of man because of our inability to devise apparatus with which to harness them successfully, for, as a matter of fact, a great deal of ingenuity has been displayed in this direction, and the cost of the mechanism, with reference to the power recovered, has probably been reduced to nearly as low a point as is possible. In the matter of simplicity and durability equally good results have been obtained.

An analysis of the most salient features of these forms of energy will show why they are not utilized on a more extensive scale. The power of waves and tides is only available along the seacoast, where, as a rule, power is not in demand; furthermore, any kind of apparatus made to utilize this energy must be very strong and bulky in comparison with the power it will give, and as a consequence very costly. In addition to this, the amount of energy will vary greatly at different seasons; hence the output that can be depended upon at all times must be far below the actual capacity of the apparatus. A further drawback is the great irregularity of the power, which renders it of little value unless means are provided for reducing it to a delivery at a uniform rate.

Windmills are not so much restricted, as to location, as the foregoing, but they are very large in comparison to the work they can do, and, as the velocity of the wind may drop to nearly zero for a long period of time, their average capacity, taking the year through, may be exceedingly small.

Solar energy is available everywhere, but the capacity of an apparatus made to utilize it would be very indefinite and far below its maximum, owing to the fact that cloudy weather may come at any time and continue for days or even weeks.

The irregularity of the power derived from these sources can be overcome by resorting to some form of storage, but this would not help, except to a limited extent, to increase the average output; therefore, when the apparatus was working at its full capacity, there would be a large surplus of power going to waste. By increasing the capacity of the storage reservoirs, the average output could be increased, and if the intervals of time during which the energy developed is little or nothing were short, say two or three days, and were followed by corresponding intervals of maximum output, it would probably be profitable to make the capacity great enough to store all the surplus developed at times of maximum output; but, as these periods may each extend over two or three weeks, it is evident that about the best we can do is to increase the average output slightly by using a greater storage capacity.

As these natural forms of energy can be obtained without cost, and the fuel used by a steam engine has to be purchased, it is apparently reasonable to assume that they would constitute a more economical form of power, but wherever a constant supply is desired it is very doubtful whether the economy of the steam engine can be superseded by any one of them. It is true that there is no expenditure for fuel, but the interest on the extra cost of the plant and the maintenance thereof, as well as the additional space required, may more than offset this gain; and the fact that so little is done in the way of utilizing them would seem to show that up to the present time their value has failed to make any great impression upon engineers who have looked into the subject. It does not follow from this that they will never come into use on a more extensive scale than at present, but it does follow that the dreams of those who believe that they will eventually supersede all forms of prime movers that consume fuel will never be realized. Through the increased value of fuel or the reduced cost of construction of the apparatus, or both, they may become competitors to a greater or less extent, but more than this can not be expected.

Considering, now, the effects of the solution of the problem of obtaining electricity direct from coal, it can be said that it is far more likely to revolutionize the affairs of the world than the utilization of the natural forms of energy; but it must also be said that we are not justified, in view of what is now known in relation to the subject, in assuming that it will ever realize the predictions of the oversanguine prophets. If we could solve the problem according to our ideal, all that is expected of it would be accomplished; but such a solution is highly improbable, if not actually impossible. Our ideal battery would be as simple as a boiler, and be provided with a place where coal could be fed in and another through which the residue could be removed. In a boiler, the pressure of the steam, as well as the quantity generated, can be increased by simply increasing the size of the fire box, but this simplicity could not be obtained even in our ideal battery, because the electromotive force would remain the same no matter how much the size of the cell might be increased. To obtain an electromotive force high enough for practical purposes it would be necessary to use a large number of cells, and, to feed these without too much trouble, it would be necessary to devise an automatic feeder capable of operating with a degree of perfection hardly obtainable without the aid of human intelligence.

It may be permissible to dream of such perfection, but we are not justified in assuming that it is possible. Electricity can be obtained from chemical action only when the material acted upon is in the electric circuit. If two metals are placed in a solution that can decompose one of them, an electric current will flow in a wire the ends of which are attached to the two metals. If two solutions capable of acting upon each other are separated by a porous partition, and into each a plate attached to a wire is immersed, a current will flow. If in a solution two metals that are not acted upon are immersed, a current will not flow in a wire connecting them. If into this solution pieces of metal or other substances that will be acted upon are dropped, no current will be generated, because the chemical action takes place between substances one of which is not in the electric chain. Coal is not a conductor of electricity, in the practical sense; therefore it can not be used directly in the electric circuit, even if we could find a way to oxidize it satisfactorily; hence the only probable way of solving the coal-battery problem is by some indirect process, and this may introduce complications great enough to entirely offset all the advantages.

The belief that great development will be made along the lines discussed in the foregoing is confined to those who possess some familiarity with scientific matters, but the general run of intelligent people only have a vague idea of what may be expected from these sources, and the pictures drawn by their imagination in relation thereto are decidedly hazy; with them the greatest of all future achievements is the solution of the problem of aërial navigation. This belief is undoubtedly due to the fact that the theoretical limitations are not understood, or are not taken into consideration, and as a consequence the average conception of a perfect air ship, as well as its movements and velocity, is very different from the actual possibilities.

The most striking difference between imagination and possibility, in this line, is perhaps in the relation between the size of the ship and its carrying capacity, the latter being always greatly magnified. An examination of any considerable number of the illustrations of flying machines would show this point very forcibly. In many of these pictures the force of gravity is treated with the utmost contempt, the ship being made apparently of sheet iron, very similar in shape to a submarine torpedo boat, the sustaining power being obtained by means of one or more moderate-sized propellers mounted upon vertical shafts, or else equally small aëroplanes. In those designs that display a greater regard for the laws of Nature, the disparity in the proportions is not so great, but in all of them it is very decided.

It is evident that with our present knowledge of science there are only two ways in which an air ship can be kept afloat, one by the use of a balloon and the other by means of aëroplanes. In the former the sustaining capacity is small relatively to the volume, being about one pound for every fourteen cubic feet; and with the latter it is small relatively to the surface, being probably not over one pound to the square foot. From this it can easily be seen that the carrying capacity, even of a craft of large dimensions, must be small, very much smaller than the popular notion would make it. The sketch presented herewith will give a fair idea of the difference between reality and the general ideal, the small car shown in solid lines being large enough to carry all the passengers or freight that the balloon could sustain, and the one in dotted lines about the size generally shown in illustrations of air ships. The sketch is not above criticism, since it does not give the location of the motor or any means for revolving the propeller, but that is a peculiarity of the majority of air-ship pictures, and the writer may be pardoned for following a common custom, especially as the object of the sketch is only to show the relation between size and carrying capacity.

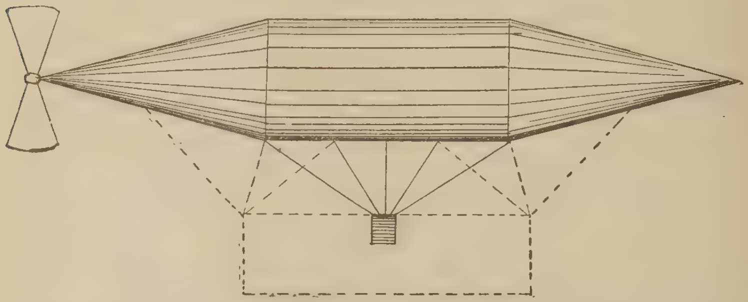


Diagram showing Difference between Supposed and Actual Carrying Capacity of Air Ships.

That this sketch is not exaggerated can be easily shown. The balloon is supposed to be one hundred and twenty feet long and twenty feet in diameter, the taper at each end being forty feet. From these dimensions it will be seen that the displacement is about twenty-one thousand feet, and the sustaining capacity about fifteen hundred pounds. Now, the first thing that any conservative engineer would admit would be that the apparatus could not be constructed within this weight if the same factor of safety were used as is customary in designing any ordinary structure; hence, if any carrying capacity is to be obtained, the weight and strength of every part must be reduced to a point not regarded as permissible in ordinary practice. Following this course, we can assume the weight of the whole ship at one thousand pounds, which would certainly be light considering its size; we would then have a net carrying capacity of five hundred pounds—equal to, say, four men. The car is drawn four foot square and six feet high, which is ample for four passengers. A contemplation of the difference between the size of the balloon and the car is enough to dampen the ardor of the most enthusiastic believer in the possibilities of aërial navigation.

It may be claimed that by the use of aëroplanes the size can be considerably reduced, but this is doubtful; and if it can, it probably would not be any benefit, since, if the area of the planes is reduced, the pressure must be increased, and this would result in a less efficient application of the energy required to keep the ship in the air. Another mistaken notion that is accountable in a great measure for the belief in the wonderful possibilities of aërial navigation is that great velocity could be obtained. This assumption is entirely erroneous, and as a matter of fact it can be easily shown that higher speed can be attained on a railroad. As is perfectly well known, the principal obstacle that stands in the way of extraordinary velocity on railroads is the resistance of the atmosphere, and this would be very much greater in the case of an air ship owing to the increased size. The cross-section of a train of cars is less than one hundred and fifty feet, while that of an air ship of the same carrying capacity would probably be ten times as great if not more, and the power required to overcome atmospheric resistance would be in about the same proportion. From this it can be seen that the energy necessary to propel the ship, without saying anything about that required to keep it in the air, would be many times greater than that required to drive a train of cars at the same speed; hence, as a means of rapid transit, aërial navigation could not begin to compete with the railroad.

There is another direction in which the air ship would be seriously defective, and this is almost always overlooked, and that is in the matter of making landings. Being a large body, it would necessarily be unwieldy, and its motion in any direction could not be arrested in a very short space of time; therefore it could not make a landing within a limited area. In a dead calm it could probably be lowered in nearly a vertical line, and thus make a landing in a contracted space, but if the wind were blowing even at a moderate velocity the case would be different. As the wind is always blowing more or less, and as it frequently changes its course in a few seconds, the ship would be tossed about quite lively before it reached the ground. If it came down at the rate of three hundred feet per minute, which is a high velocity, and the wind were blowing at the rate of ten miles per hour, the side drift would be three times as great as the vertical descent; and if this were counteracted by imparting a velocity to the ship equal to that of the wind and opposed to it, the side draught would be doubled if the direction of the wind should suddenly reverse. It must therefore be evident that to be able to make a landing safely, without running the risk of colliding with church steeples and modern sky-scrapers, it would be necessary to have a large open space, and in order that the passengers might not have to walk a large portion of the length of their journey conveyances would have to be provided to transport them from the place where the ship might land to the station entrance.

It must not be assumed from what has been said in the foregoing that the writer regards the solution of the problems here considered as of no special value, for his views are just the opposite of this. The object aimed at has been to show that the wonderful things that it is expected will be accomplished by the solution of these problems will never be realized with regard to some because they are not possible, and are not likely to be realized by the others on account of inherent defects that the solutions may bring to light. The coal-battery problem will, no doubt, be worked out, in some form or other, but who can tell whether the objectionable features of it will or will not offset all its advantages? The hot-air engine is a far more perfect converter of energy, in theory, than the steam engine, but its defects when reduced to a practical form are such that it is of no value except for small power, and this may also turn out to be the case with the coal battery. The utilization of the energy of tides, solar heat, etc., is as possible to-day as at any future time; the fact that they are not utilized is proof that they are not considered as desirable as other forms of energy. In the future the cost of the apparatus for harnessing them may be so reduced as to render them available to a much greater extent than at the present time, but that they will ever revolutionize the industrial affairs of the world and drive the steam engine out of use is hardly a remote possibility. Aërial navigation will, no doubt, be accomplished, but in the opinion of the writer it will never be used for commercial purposes, simply because it can not, even if developed to the highest state of perfection, compete with transit on the surface of the earth, either in speed or cost of transportation. It may be used in warfare, but more than likely it will be confined to pleasure purposes.

THE highest value can obviously be given to present research by directing it chiefly to those departments which are undergoing most rapid changes and therefore most urgently demand immediate study. The subject is thus regarded by Prof. A. C. Haddon, who, trying to put himself at the point of view of our successors a hundred or a thousand years hence, asks, in Nature, what they would wish we had done. Studies in the structure, development, and physiology of animals, polar research and deep-sea research, will not suffer materially if the pursuit of them is delayed; but "our first and immediate duty is to earn for science vanishing knowledge; this should be the watchword of the present day." In this category are the study of native fauna and flora before they are exterminated or crowded out or mixed with introduced species, and the study of native man before he is contaminated by contact with civilization. The opportunity for these studies is diminishing, and once lost can never be recovered.

SOME FACTS ABOUT WASPS AND BEES.

By Dr. R. W. SHUFELDT.

ONE of the most extensive and at the same time one of the most interesting groups of insects in the entire range of entomology is that order which has been created to contain the ants, bees, and wasps with their numerous allies. This association was called the *Hymenoptera* by Linnæus, the name having reference to the fact that the anterior and posterior wings of the winged forms are, during flight, connected together by a row, upon either side, of small hooks. This is Kirby's suggestion (Text-book of Entomology, page 103), but it would seem more probable that the word *Hymenoptera* was derived from the Greek *hymen*, a membrane, and *ptera*, wings.

Primarily, this order is divided into the *Terebrantia* and the *Aculeata*. In the first named the ovipositor is employed as a borer, while in the second it has become modified into a sting. These two subsections are by various classifiers again divided into several other divisions, and these again into families, genera, etc., as in the case of other natural alliances of animals. Both the habits and structure of the insects included in this group are characterized by great variety, and the majority of its members exhibit an extraordinary amount of intelligence, especially this being true in the case of the ants and wasps. A perfect host of parasitic insects also belong to this group, attacking both the larvæ and eggs of other insects. Were all the literature extant that has been devoted to the ants alone got together, it would form by no means a small library; but such a library would be completely overshadowed were it compared with a similar one collected in the case of bees. Of the common honeybee alone, Mr. John Hunter, the late Secretary of the British Bee Keepers' Association, has said: "No nation upon earth has had so many historians as this remarkable class of insects. The patience and sagacity of the naturalist have had an ample field for exercise in the study of the structure, physiology, and domestic economy of bees; their preservation and increase have been objects of assiduous care to the agriculturist; and their reputed perfection of policy and government have long been the theme of admiration, and have supplied copious materials for argument and allusion to the poet and the moralist in every age. It is a subject that has been celebrated by the Muse of Virgil and illustrated by the philosophic genius of Aristotle. Cicero and Pliny record that Aristomachus devoted sixty years to the study of these insects, and Philiscus is said to have retired into a remote wood that he might pursue his observations on them without interruption. A very great number of authors have written express treatises on bees, periodical works have been published relating exclusively to their management and economy, and learned societies have been established for the sole purpose of conducting researches on this subject." When we have such facts as these before us one is enabled to form some estimate as to what the literature of the entire order *Hymenoptera* would amount to as a whole.

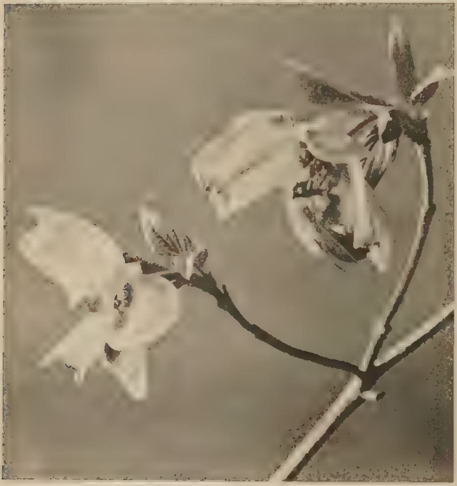


Fig. 1.—Bumblebee upon Dogwood Flower. From a photograph taken life-size by Dr. Shufeldt and considerably reduced.

Nor has the historical naturalist neglected the wasps in his labors, for the literature upon these remarkable insects is likewise very voluminous. They constitute the true *Hymenoptera aculeata,* Kirby using the term *Diploptera,* dividing them into three families. Of these, the social wasps (*Vespidæ*) are represented by a number of genera in various parts of the world, containing a host of interesting species. Some of these are of small size, while others stand among the biggest of the entire group. One form found in China and Japan measures two inches across the wings. Many of these wasps sting with great severity, and it has been related of Mitchell, the Australian explorer, that he was stung by a species found in that country, and the pain caused thereby forced him to scream out with agony. It had the effect of temporarily paralyzing his leg, and the great spot on the limb occasioned by the injected poison did not disappear for at least six months. Many wasps are brilliantly colored, while the external structural parts of others are extremely unique. For example, the *Masaridæ* of Africa and Australia is a family in which the antennæ present a great variety of shapes, some of them even being clubbed, while others are extremely long and slender. Numerous species of wasps and hornets are fossorial by habit, either constructing underground burrows for themselves or else occupying those formed by other insects. Some of these types are very large, some are small, some are solitary by habit, others live in communities. We have one big species of fossorial wasp that I have studied at various points in the Atlantic coast States. Last spring there was a large colony of these established beneath the sweeping limbs of a fir tree near the main entrance to the Smithsonian Institution. The ground in this locality was riddled with their burrows. A great many cases of the sting of this formidable wasp are known to me. Years ago I knew of a case where a passenger upon a Mississippi River boat was stung by one of them on the back of the neck, and the man died eventually from the effect of it. The insect was knocked down on the deck at the time, and was found to be bearing a large cicada in its mandibles.

Some of the smaller fossorial wasps appear like large ants, the females being without wings. They also have a sting, and are clothed with a fine hairy coat, often of a bright yellow or brilliant vermilion. In New Mexico, in sandy places, I frequently saw these insects, but never more than one at a time, and only a few in the course of a day. They have been called "solitary ants" (*Mutilla* ?). There are hundreds of species in the world of these fossorial wasps, some winged, others wingless; some very small, others measure three or four inches across the wings (*Pepsis*, etc.); while many of them exhibit the most wonderful coloring in metallic blues, greens, reds, and yellow. Nearly all have the habit of paralyzing other insects by stinging them, then carrying their helpless victims to their subterranean nests, where they are buried alive by the side of their eggs, so that when the larvæ are hatched out they find a fresh repast awaiting them in the form of these living but paralyzed spiders, caterpillars, etc. The "mud daubers" have the same habits, and we all know them, and how they, with pellets of mud, build their curious cells against walls and fences and in all sorts of places about our country houses. These are great species to paralyze spiders and place them in these mud cells and sealing them up afterward for the future use of their young (*Pelopœus*). When collecting in New Orleans I frequently did a good day's work in spider collecting by cracking open these mud nests. Packard also refers to those sand and mud wasps that dig deep holes in our gravel walks and have the instinct to sting grasshoppers in one of the thoracic ganglia, thus paralyzing the victim, in which the wasp lays her eggs; and the young, hatching, feed upon the living but paralyzed grasshoppers, the store of living food not being exhausted until the larval wasp is ready to stop eating and finish its transformations (*Sphex ichneumonea*).

In a paragraph above I have referred to the family *Vespidæ* of the group *Diploptera*,* and it includes some of the most interesting wasps and hornets of which we have any knowledge. So far as it is known to me, the *Vespidæ* are all *social species*, the individuals consisting of males, females, and neuters. They are also known as the "paper-making" wasps, having the habit of constructing paper nests of various sizes and forms in which their young are reared. Our common brown wasps (*Polistes*) are too well known to require any detailed description. To those living anywhere in the Atlantic States their paper nests are very familiar, being formed of a circular disk of a single tier of cells, being suspended at the solid back by a median pedicle attached to the point chosen by the community to build. Usually these cells face downward, but occasionally the plane of the nest is vertical or nearly so, causing the long axes of the cells to lie horizontally, or more or less obliquely. This grayish, papery stuff used by the paper-making wasps is a composition of their own manufacture. In the case of the common wasp it is made by the female (*Vespa vulgaris*), she using the fibers of old wood for the purpose. These she gnaws and kneads until they come to be of a consistence of *papier-maché* pulp—the mixture being assisted by the secretion of the salivary glands of the insect.

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* From the Greek *diplos*, doubled, and *ptera*, wings, referring to the fact that the representatives of this family, when in a state of repose, fold their fore wings longitudinally.

The paper hornet (*Vespa maculata*) builds often a very large and elaborate nest of this material. These structures are frequently found in various localities in the eastern United States and elsewhere. The year before last a colony of them built beneath the eaves of the tower to my residence in the suburban parts of Washington, D. C. A great paper nest filled the entire angle of the recess. When they build in the forests, however, these insects usually select the smaller limbs of bushes or trees, making the nest more or less spherical or ellipsoidal in contour. Sometimes these are placed high up in the trees, but again may be close to the ground. Two years ago I discovered a deserted one near my present home that was fastened to the twin trunks of a small dogwood, its lower surface being practically in contact with the ground. It was of an egg-shaped form, with the small end downward; the entire affair measuring about thirty centimetres by twenty-two centimetres, selecting for the purpose the greatest vertical diameter and the longest horizontal one (see Fig. 2). Eight distinct layers composed the walls of this nest, and its entrance, a small oval opening, was situated low down in front. It contained three tiers of unipedicled nests of cells, they being closely packed together, and the disks faced downward and were about a centimetre apart. As usual, any single cell was in contact with all its juxta-placed neighbors, and when not too closely crowded they were seen to be of a cylindrical form, but if the crowding was closer they then assumed the hexagonal shape. At their bases they were rounded, while inferiorly they were open and exhibited the various means by which the young had escaped when the proper time had arrived for them to do so. In some cases the thin paper cap was perforated; in others it had been lifted as a cover; while, finally, in some it was practically gone altogether. Paper hornets will, as every one knows who has ever had any experience of the kind, sally forth in numbers and protect their nest by winged attacks *en masse* and in loose order, their stings being no trifling matter in many cases. I have before me another very pretty nest of this kind found in the same locality, but built by a different species. It is no bigger than an ordinary peg top, being attached to the twig of a blackberry vine by its large end, the apex, looking directly downward, being occupied by a single circular aperture leading to the interior. Externally this little structure is very smooth, and it contains but one small disk, composed of but seven or eight cells.

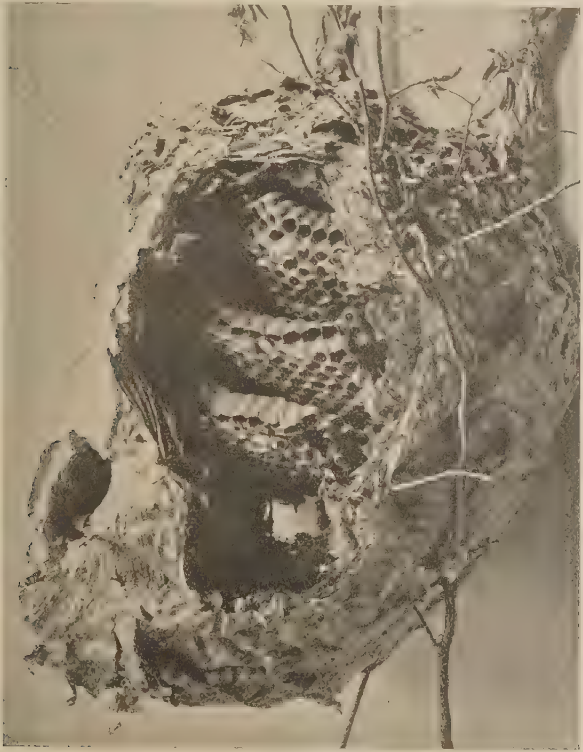

FIG. 2.—NEST OF THE PAPER HORNET (*Vespa maculata*). One side cut away to show interior. Collected and photographed by Dr. Shufeldt.

Other communities of social hornets build their vespiaries in the hollows of trees and logs, which they occasionally clean out to render the places fit for their purposes.

Arthur Shipley, in describing some of the habits of the *Vespidæ,* has said in part that the workers among hornets "are females in which the ovary remains undeveloped; they resemble the perfect female in external appearance, but are slightly smaller. Unlike the bees', the wasps' community is annual, existing for one summer only. Most of the members die at the approach of autumn, but a few females which have been fertilized hibernate through the winter, sheltered under stones or hollow trees. In the spring and with the returning of warm weather the female regains her activity and emerges from her hiding place. She then sets about finding a convenient place for building a nest and establishing a new colony."

The methods of making the paper cells and their arrangement, the laying of the eggs in them, and the rearing of the young are practically much the same in both the common wasps and the social paper hornets. So Professor Shipley, after describing the manufacture of the paper nest of the common wasp (*Vespa vulgaris*)—how she lays a single egg at the bottom of each of the first three cells, and then this, the foundress of the society, "continues to add cells to the comb, and as soon as the grubs appear from the first-laid eggs she has in addition to tend and feed them."

"The grubs are apodal, thicker at the middle than at either end; the mandibles bear three teeth; the maxillæ and labium are represented by fleshy tubercles. The body, including the head, consists of fourteen segments, which bear lateral tubercles and spiracles. They have no arms. They are suspended with the head downward in the cells, and require a good deal of attention, being fed by their mother upon insects which are well chewed before they are given to the larvæ, or upon honey. At the same time the mother is enlarging and deepening the cells in which they live, building new cells and laying more eggs, which are usually suspended in the same angle of each cell. The development within the egg takes eight days.

"After about a fortnight the grubs cease to feed, and, forming a silky cover to their cells, become pupæ. This quiescent state lasts about ten days, at the end of which period they emerge as the imago or perfect insect. The silky covering of the cell is round or convex outward, and to leave the cell the insect either pushes it out, when it opens like a box lid, or gnaws a round hole through it. As soon as the cell is vacated it is cleaned out and another egg deposited. In this way two or three larvæ occupy successively the same cell during the summer. The first wasps that appear in a nest are neuters or workers, and these at once set to work to enlarge the comb and feed the larvæ, etc. . . .

"In a favorable season, when the weather is warm and food plentiful, a nest may contain many thousands of cells full of wasps in various stages of development, and, as each cell is occupied two or three times in the course of a summer, those authorities who put the number of the members of the community as high as thirty thousand are probably not far wrong.

"At the approach of autumn the society begins to break up; the males fertilize the females while flying high in the air; they then die, often within a few hours. The workers leave the nest, carrying with them any grubs that remain in the cells, and both soon perish. The nest is entirely deserted. The females which have been fertilized creep into crevices under stones or trees or hide among moss, and hibernate until the warmth of the following spring induces them to leave their hiding places and set about founding a new community."

Where hornets or wasps occur in very large numbers they frequently, at certain seasons, do considerable damage to fruit and forest trees by gnawing off the bark to build their paper nests. They destroy the fruit they attack, living as they do upon the juices extracted from it. But, on the other hand, these insects are very useful in that they likewise feed on flies and other insects, and so very materially diminish the numbers of these pests. Some wasps live in part upon honey, which they collect from the most open-petaled flowers, and thus to a very moderate extent they may be regarded in the light of flower fertilizers. Kirkland says, in the first volume of the American Naturalist, that "the paper hornet (*Vespa maculata*) often enters my nucleus hives, when I am rearing Italian queen bees, and captures the young queen in the midst of her little colony, usually just after she has commenced her first laying. I have seen this depredator enter the small hive, drag out the queen, and fly away with her to the woods" (page 52). Some of the species of the genus *Polistes* store up honey which is poisonous, from the fact that it has been collected from poisonous flowers. They are found in South America, where also species of the genus *Chartergus* occur—wasps that make a very remarkable and tough nest, with funnel-shaped combs inside, arranged one inside of another, nest fashion, but not in contact except at their points of suspension. At the apices of these cones occur the apertures of entrance for the inmates to pass up among the conical tiers. *Icaria*, a genus represented in Australia, the East Indies, Africa, and Madagascar, contains some very remarkable species. Some of them have the power of contracting the hinder segments of the abdomen so far within the body that at first sight they appear to have been broken off. Many of these species are very small and brilliantly colored, and often build curiously shaped little paper nests.

Wasps and hornets are not without their enemies, for their nests are frequently infested by parasitical insects that feed upon their grubs. According to Shipley, "In the tropics some species are attacked by fungi, the hyphæ of which protrude between the segments of the abdomen and give the wasp a very extraordinary appearance."

From the wasps and hornets I next pass to a consideration of a few of the species of bees, omitting, however, anything in reference to the common hive bee (*Apis mellifica*), of which insect entire volumes have been written.

Hundreds of species of wild bees are now known, and they are to be found in almost every part of the world, and doubtless many species yet remain to be described by the entomologists. Those found have been arranged in the two families *Andrenidæ* and *Apidæ* by Kirby, and are subdivided into a number of genera. In the first family all the species are solitary of habit, while in the second both solitary and social species are found. True honeybees are found wild in this country, and the species most nearly allied to them with us is the common bumblebee (*Bombus*), of which genus upward of fifty species or more occur in North America. This bee, or rather a queen of this species, hibernates all winter, but early in the spring makes her nest. This may be under any old log or piece of turf or the vacated nest of a field mouse. A dozen eggs or so are laid in a mixture she makes of pollen and honey, and the young appear in series from egg to imago, the period of development being of no great length. From this time on the study of the colony is full of interest, but the sequence of events is not altogether unlike what has been described above for the wasps, the nature of the nest and the fate of the eggs when first deposited being the main difference.

Bumblebees are preyed upon by a variety of parasites, the most curious being a species of *Apathus*, an insect so closely resembling its host that it requires the eye of an expert to detect the one from the other. Many of us are familiar with the history of the tunnels in posts, planks, and similar places made by that large species known as the Virginian carpenter bee (*Xylocopa virginica*); and then, too, we have its pretty little ally, the bright pea-green *Ceratina dupla*, that constructs similar tunnels in such plants as have a pithy center, as reeds and elderberry bushes. These tunnels in either case are intended to hold the cells in which the eggs are deposited and the young reared. The habits of the tailor or leaf-cutting bee are even still more interesting (*Megachile centuncularis*). They have strong, sharp-cutting jaws, by means of which they cut away bits of leaves to be used in the formation of their cells, the site of the nest being in elder stalks or under planks or in the hollows of certain trees. Their very interesting habits have been closely studied by a number of naturalists. Mason bees of the genus *Osmia* are also small and brilliantly colored, blue or green, having habits somewhat akin to those of *Megachile*. A European species is said to build her cells of mud, depositing them in the empty shells of snails. Many other species of this genus *Osmia*, in various parts of the world, possess habits full of interest to us, that have been described in the books with greater or less detail. Then we have the less intelligent types of those bees that burrow in the ground, that are solitary, and leave their young to look out for themselves. These fossorial bees see their types in such forms or species as the common *Andrena vicina*, that I have observed in many parts of New England. Parasitic bees, called cuckoo bees (as *Nomada sex-fasciata*), prey upon these fossorial forms, such as *Andrena* or its allies of the genus *Halictus* and others, by laying their eggs in their nests. They are also infested by numerous other parasites, such as by certain ichneumon flies and oil beetles (*Meloë*), and others. Some of the South American bees are destitute of stings (*Melipoma, Trigona*), and I have frequently seen a large bee here near Washington that does not sting. It has the appearance of a *Bombus*, but the fore part of the head is nearly all of a very pale yellow, almost white.

Carder bees (*Bombi muscorum*) are known to all frequenters of open fields and meadows, after the haying season has commenced. A popular writer at hand says: "They select for their nest a shallow excavation in the ground about a foot in diameter, or, if such a one is not to be found, they make one with prodigious labor. This they cover over with a dome of moss, or sometimes with withered grass. They collect their materials by pushing them along upon the ground, working backward like the tumblebugs. Frequently in the spring a single female founds a colony, and by perseverance collects the mossy covering in the way described; later in the season, when the hive is populous and can afford more hands, there is an ingenious division of this labor. A file of bees, to the number sometimes of half a dozen, is established from the nest to the moss or grass which they intend to use, the heads of all the file of bees being turned from the nest and toward the material. The last bee of the file lays hold of some of the moss with her mandibles, disentangles it from the rest, and, having *carded* it with her fore legs into a sort of felt or small bundle, she pushes it under her body to the next bee, who passes it in the same manner to the next, and so on till it is brought to the border of the nest—in the same way as we sometimes see sugar loaves conveyed from a cart to a warehouse by a file of porters throwing them from one to another. The elevation of the dome, which is all built from the interior, is from four to six inches above the level of the field. Besides the moss or grass, they frequently employ coarse wax to form the ceiling of the vault, for the purpose of keeping out rain and preventing high winds from destroying it. Within this retreat the eggs present an appearance not very different from that of the bumblebee."

In conclusion, I may say that among the ancient Hebrews and Romans the error was widely credited that bees made their nests and reared their young in the carcasses of dead animals; and, although these people knew that bees were governed by a ruler, they labored under the impression that it was a king and not a queen. Such ignorance can easily be overlooked, however, when we come to consider that it is only of comparatively recent date that we have worked out the biology of these insects, and, as it is, there yet remains the greater part, by all odds, of their natural history of which we know little or absolutely nothing, and to which must still be added that of the host of species of this order yet to be discovered and made known to science.

THE PRINCIPLE OF ECONOMY IN EVOLUTION.

By EDMUND NOBLE.

ONE of the many interesting things about evolution, oftener taken for granted than formally recognized, is the fact that the changes which everywhere accompany and constitute it have their rise in a simple excess of pressure in one direction over the pressure in another. For all movement, whether it be of simple or of complex matter, whether it be of an inorganic or an organic system, whether it involve will and conscious perception or not, is in every case and under every conceivable set of circumstances movement in a single mode—that is to say, movement in the direction of the least resistance, or from the direction of the greatest traction or stress.* If we look to the origin of the movement, we shall speak of acting as in the line of the greatest stress; if we consider the resistances in the presence of which movement is produced, we shall regard acting as in the direction of the least resistance. But, however we may describe it, the truth of the law is obvious, since it follows from the very nature of movement. For if a body be equally stressed from all directions it will not move, while if it be stressed differentially—in one direction more than in other directions—it will move in the line of, or away from, the greatest stress. Now, as all movement must take place in the presence of or against resistance, a body which moves in the line of the greatest stress necessarily moves in the direction of the least stress, and it is this movement in the direction of the least stress which we mean when we speak of movement in the direction of the least resistance.

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* In order to save repetition, the word "stress" will be used throughout in the sense of traction or stress."

We have next to note what is meant by the greatest stress. This is not necessarily a stress applied at a single moment in time or at a single point in space. The movement of a billiard ball, for example, may be determined for part of its course wholly by the blow given with the cue, but the cushions soon come into action, and thus the total course of the ball is decided, not solely by the cue, but by the cue and all subsequent stresses of the cushions and balls that happen to be struck. In like manner, the initial impulse is given to the cannon ball by the exploding gunpowder, yet this initial stress is immediately complicated with gravitative action; and when we say that such a ball moves in the line of the greatest stress, we mean not simply the direction originally given by the cannon, but the whole direction as determined by cannon, gravity, and atmosphere. The greatest stress determining the direction of movement, then, is a stress made up, not only of the initial stress, but also of all subsequent determinations encountered as resistances by the moving body in its course; and when we say that a body moves in the direction of the least resistance, we mean that its total movement is determined by the total of greatest stresses. It is true that a distinction may be made between the original impulse given to a body and the subsequent stress or stresses entailed upon it by its own movement, and due to contact with other bodies at rest or in motion. It is an active stress, for example, which gives the initial impulse to the billiard ball; it is a reactive stress by which the cushion deflects the ball from its original course. But this distinction is little more than formal; the whole of the stresses determining movement, however easy it may be to analyze them into parts, must be regarded in their totality; for if we have to account for movements that take place in time in their totality, we must consider the determinations to those movements in their totality.

The law of least resistance, as we may briefly call it, finds exemplification alike in the realm of life and in the world of inanimate things. Not only are all movements of masses and their parts—from the descent of a bowlder down the hillside to the revolutions of planets in their orbits; from the activities of gas molecules in a chemist's laboratory to the movements of cosmical aggregation out of which suns arise—due to a differential stress producing motion in the presence of resistance to that motion: the law is valid also for the activities of animals, since, if the molecular forces embodied in an organic system impel that system to move to particular ends in the interest of maintenance, it can not move to such ends save in the direction of the least resistance. Thus, if a stone thrown at a mark takes the shortest route, having regard to the whole of the influences which act upon it, so a pedestrian goes to his destination by the shortest way which the circumstances permit. A volume of steam finds exit from an overstrained boiler at the weakest point; so by the weakest point an animal escapes from its cage. As a river flows through its channel, determined to that path by the resistance which prevents deviation from it, so the traveler is held to the beaten track by the broken and difficult ground on each side of it. A bullet is diverted by some obstacle suddenly encountered; the root of a plant coils round the stone it meets; the railway engineer usually carries his line round an obstruction instead of through it; the secondary current of an induction coil avoids a journey of many miles by leaping through a flaw in the insulation; a dishonest pupil avoids work at examination by copying the replies of a fellow-student. The light wave makes its way, roughly speaking, spirally through ether; objects of large surface and slow descent, such as certain suitably shaped pieces of paper, descend through the atmosphere in a spiral path; a bubble of air ascends spirally through water; the plant climbs a tree by spiral windings; a horse mounting a steep ascent with a heavy load takes a zigzag or spiriform course; men ascend and descend by spiral stairways; water sinks through an orifice spirally, and the descent of a whirlpool is a spiral; boring instruments, such as gimlets, augers, corkscrews, have spiral blades. The hunter seeks particular animals at pools and watercourses which they frequent, as certain medusæ throng to water traversed by a beam of light because the illumination attracts thither small crustacea upon which they feed. Earthworms, in drawing leaves into their holes, seize the leaf at such a point as will permit its passage into the hole with the least amount of resistance; a man carrying a ladder on his shoulder through a crowded thoroughfare carefully regulates his movements so as to avoid collisions. Men escape from an invested city by utilizing the wind; the invested dandelion balloons its seed to a place where it can grow in safety. Certain organisms wear the garb of others in order to increase the ease of their existence; certain men mimic their fellows to the like end of diminishing resistance. As a mother disguises her child's medicine in sugar or sirup, so plants offer their seeds to animals in sweetly flavored fruits. Bees construct their combs in the form that secures the utmost capacity for storage with the smallest expenditure of building material and therefore of energy; so human builders attain in their constructions a maximum of needed effect with the lowest minimum expenditure of material and labor. A general carrying on war, a statesman conducting affairs of government, a merchant engaged in business negotiations, alike take the path which, having regard to the whole of the circumstances, offers the least amount of resistance to the attainment of the ends in view.

All inorganic and organic movements are therefore alike in the fact that each is due to a greatest stress, and takes place in the direction of a least resistance. It is true, of course, that a pedestrian does not rebound, like the billiard ball, from the resistances which he encounters in trying to find the easiest path through a forest or over the mountains; yet he consciously seeks the path of least resistance, and does so because he is diverted into it by the greater resistances of all other paths; these greater resistances become part of the greatest stress which determines the form of his movement, just as the reactive stress of the cushions forms part of the greatest stress that determines the path of the billiard ball. Inorganic and organic movements differ from each other simply in the fact that by living animals the path of least resistance is more or less consciously chosen, while in the inorganic world the path of least resistance is not chosen. And this unlikeness arises out of a more fundamental unlikeness still, from the fact that movement in the realm of the organic has end for its concomitant, though not necessarily conscious end, while in the motion of things inanimate end is wholly absent. Organic movements, that is to say, are all directed to some end, while in the realm of the inorganic, movements are simply unintelligent effects, results, or products of differential stress. In the form of organic movement, end plays a most important part, while in inorganic movement it has no part at all. Thus a pedestrian may find a circuitous route through a forest the easiest if his only end be to pass through it as quickly as possible; yet, should botanizing be his object, the form of his movement will be quite different, and may very well be the direction of greatest resistance, so far as physical obstacles to movement are concerned. In the case, moreover, of particular ends, numerous opportunities for the exercise of choice present themselves. The more direct path up a mountain is chosen in preference to the one less direct, yet, when the "easier" path is the more dangerous, the traveler takes the safer and more difficult passage. So the more efficient tool is preferred to the less perfect instrument; and so, out of numberless ways in which the ends of life are to be reached, men instinctively and consciously choose those which, by encountering the least possible resistances, involve the minimum expenditure of effort. In the case of organic movements, economy of energy is possible because of the presence of end, the existence of various ways of reaching it, and the possibility of choosing the one which involves the least expenditure of energy. In the case of inorganic movements there is no such economy, since those movements are mere effects, and comply unvaryingly with the laws of mechanics. Finally, the exertion of choice by an organism does not determine whether movement shall take place in the direction of the least resistance or not—for that is the inevitable mode of all movements, organic as well as inorganic—but whether the energy expended in the differential or greatest stress producing movement shall be a larger or a smaller quantity.

We have next to note that the economy of energy which is possible in organic movements has two forms. There is economy in the realm of the conscious will, exemplified in movements by which animals reach various ends; and there is an economy in the realm of the unconscious life of the organism by which the parts thereof rearrange themselves in such a way as to lessen the expenditure of effort in the work of maintenance. For, whenever function is imposed by the organism upon certain of its parts, such parts, moving into configurations of least resistance, set up the intelligent adaptations which we know as organs. The only difference between a tool and an organ is that the former has been consciously shaped by man, whereas the latter has arisen through the unconsciously effected rearrangements of living molecules upon which function has been imposed by the organism. All organs, like all tools, are paths of least resistance, ways of reaching ends of organic maintenance with a minimum expenditure of effort. Simultaneously, moreover, with the saving of energy spared through the gradual perfecting of organs, there goes on a gradual improvement of the ends which such organs are unconsciously produced to reach. For this is simply to say that all effort saved by an organism through increase of the efficiency of its organs and processes goes—the circumstances being favorable—to increase the complexity and delicacy of its relation to the environment, as well as to enlarge the scope of the activities of maintenance.

The way in which organic molecules move into configurations that offer the least resistance to their special activities may be seen in similar structural formations which are more or less unconsciously assumed by human beings. One of these is the habit of taking turn by people waiting, say, at the box office of a theatre—a configuration which is assumed more or less unconsciously, because it is the one which, under the whole of the circumstances, involves conditions of least resistance. There is a similar selection of conformations involving a maximum of ease in the manner in which pedestrians avoid collision with each other. The throng in movement on the crowded sideways of a great city divides itself naturally and without conscious deliberation into two streams going in contrary directions, each pursuing its particular course without the slightest resistance from the other, and to the manifest advantage, both in amount of energy expended and speed of movement, of every individual concerned.

The history of social and industrial ascent is, throughout, a record of the lessening of the resistance encountered in the attainment of human ends, as well as of the constant improvement of those ends. Social ascent not only diminishes resistance within the tribe, community, or nation; it everywhere lessens external aggression, substitutes mutual aid for the antagonisms of conflict, and enables men to devote energy spent in war to the pursuits of peace. Step by step with this lessening of resistance by the reduction of conflict, there goes on within the social body, and between the group of social bodies, those co-operative movements which, by tending to unify men, gradually bring to the aid of the individual the whole power of the social organism. In the beginning there is little industrial co-operation: each man is his own agriculturist, hunter, tailor, shoemaker, and soldier—each, that is to say, discharges for himself the work which individual maintenance involves. But little by little men discover the superior ease of mutual aid, and as they learn the value of the division of labor, the function of maintenance, originally exercised almost wholly by each individual for himself, comes more and more to be distributed among sets of individuals specially differentiated for the tasks allotted to them, and finally there arise those wider interdependencies of industrial and commercial co-operation that bind the inhabitants of almost every clime under the sun in bonds of mutual indebtedness. That the whole of this movement is a movement of constantly increasing economy of energy in the reaching of special ends, and of constant ascent in the scope and perfection of those ends, will be evident when we remember that the lower we go down in the scale of human existence—to the stages where coacting is least developed—the more rudely and imperfectly are the ends of maintenance reached, and the more completely is the time of the organism exhausted in attaining them, while the higher we look in co-operation the more efficiently are those ends accomplished, and the less time is taken up in their performance.

The way in which labor is reduced and end perfected, both as to the quality of the work and the time in which it is performed, has been shown in many familiar examples of co-operative acting. The advantages of giving particular tasks to specialized sets of workmen in such processes as those of coining and pin-making is well known. The gradual improvement of tools—which are really means to the attainment of the ends of the individual and of the community of individuals, and must therefore share in the movement of ascent in which those individuals are engaged—yields in its every detail an illustration of the mode of all movement. At first, tools were of the rudest kind, and men reached their ends with labor enormous compared with that needed for the attainment of the same ends to-day; but in proportion as they acquired knowledge of the external world, of the properties of things, of how things act and may be acted upon, and of the means and methods by which desired results may be brought about—in proportion, moreover, as human need, widening and becoming more varied with human ascent, made demand for a larger number and a greater variety of implements—in such proportion did men perfect, not only their tools, but also the ends possible of attainment therewith. To the implements, moreover, once used only by individuals, there have been added the tools called into service as social appliances by groups of men, and finally by the whole community. Thus the progress of tools has been an ascent, not only from the sandals of rawhide to the shoe of civilized races, from the knife of stone to the modern blade of steel, from the sticks rubbed together to the lucifer match, from the sling to the rifle, from the bone needle to the sewing machine, and from the gnomon and the clepsydra to the timepiece—it has also meant the gradual development of such social mechanisms as steamboats, railways, street cars, post offices, telegraphs, and the like. Finally, all such improvement, whether of the individual or the social appliance, has been, from first to last, progress in the economy of the labor needed for particular ends and perfection of the ends themselves.

Illustrations of the law of least resistance may also be drawn from the realm of mind. The need of economizing energy in thought is one which, however conscious or unconscious we may be of it, dominates and directs, so to speak, all our mental activities. This is suggested by the familiar antithesis between breadth and profundity of acquirements—by the fact that artistic genius is usually divorced from depth of intellect, that speculative ability is rarely associated with knowledge of the world, that the thinker who is deeply versed in general principles is almost never a specialist, that the poet is only phenomenally a man of affairs, and that the power to think originally and philosophically and the power to excel in the graces of literary style are rarely allied in one and the same individual, or present in any individual at one and the same moment. In a general way, we can concentrate the mind, so to speak, upon any particular object only by abstracting it from all other objects; our attention to a speaker, or a book, ebbs and flows according to the interest we take in particular passages; more than half the familiar activities of our daily life are performed without any attention to them which can properly be called conscious. We are constantly, on the one hand, reserving voluntary effort for the less habitual processes and activities, and on the other committing such processes and activities, to the extent that they become habitual, to the realm of the subconscious.

What is true of our bodily activities is equally true of the mental processes through which we form judgments and reach conclusions. To men in the mass, partial aspects of reality are easier to seize than complete verities; they find "concrete facts" more comprehensible than general principles; the gently undulating slopes of belief offer them a less arduous path than that which leads over the steep cliffs of knowledge; for most of them, the rosy streamers that herald morning are more beautiful than the full lights of day:

> L'homme est de glace aux vérités—
> Il est de feu pour les mensonges!

Hence it is that in their earlier thoughts men explain the invisible parts of the external world in terms of the parts visible to them; that they confound the object with the garb woven for it by the subject; that they conceive anthropopathically of things and activities in the external world and that most of their ideas of the universe and of its parts presuppose the human organism as the source of the analogies which alone make them intelligible. There can be thus no theory of the universe, however crude, and no religious belief, however barbarous, which may not find its justification in the fact that, for a particular stage of mental ascent, it is an expression of the law of least resistance. If, moreover, the beliefs and theories of individuals and races, at first of the simplest kind, become more complex as men ascend in mental power and knowledge; and, if, as the spheres of feeling and knowing draw near to one another, each grows richer in content until in both the mind is enabled to range in a world of ideas inaccessible to man on a lower plane of development—these results are reached in every stage of the progress they constitute not only by the saving of energy through the improvement of mental operations, but also by the enlarging and perfection of the ends compassed by those operations.

The history of the concept is itself full of evidence to the same effect. In the early stage of mental development, men attach high validity to appearances, and thus form concepts which connect things only on the basis of their superficial likenesses and differences; the stage is one in which, while there are terms for the members of a class, those descriptive of the class are either very imperfect or do not exist at all—one in which, for example, there are names for particular trees, particular plants, particular animals, but no general name for tree, for plant, or for animal. Not only are objects imperfectly known in the absence of the power to form these general concepts; it is impossible to think of them in their proper relations to one another, and thus there is at once imperfect knowledge of the external world on the one hand, and on the other, through lack of the bond of likenesses between classes, that comparative slowness of mental processes which must have been a character of all early thought. The more imperfect, in fact, are the links of likeness which binds concepts together, the more the mind tends to resemble the confusion of an unclassified library, where the needed volume can be obtained only by great expenditure of time and effort; the more complete is mental segregation, the more the mind may be said to resemble the same library properly classified. Ascent, therefore, from the knowing of things by their superficial characters to knowledge of them also in their fundamental characters enormously increases, not only the ends reached by thought, but also the ease and rapidity of mental operations.

There is another economy to be noted in mental operations—the economy wrought by the increasing content and the growing symbolism of the concept. The name first given to any object simply expresses the most prominent out of a very small number of qualities by which we know that object. In onomatopoetic words, for example, the quality perceived and named is one of sound, and the process gives rise to such terms as *kolokol*, the Russian word for "bell"; *gunguma*, the Gallas name for "drum"; *kwalalkwalal*, used for "bell" by the natives of Yakama (North America); *tumtum*, also a Gallas word, meaning "workman," or, more literally, "hammerer"; *krakra*, the name of a Dahoman watchman's rattle; *chacha*, the Aino word for "to saw"; the Peruvian *ccaccaccahay*, signifying "thunderstorm"; the Australian *bungbungween*, used for "thunder"; *hou-hou-hou-gitcha*, the Botocudo word for "to suck"; *kakakkaka*, which in Dyak means "to go on laughing loudly"; *shiriushiriukanni*, used by the Ainos in the sense of "a rasp"; and the Quichua *chiuiuiuinichi*, indicating the noise made by the wind among trees. At first, that is to say, the name means no more than the most prominent character, and perhaps the only known character, of the object to which it is applied, whether that character be one of sound, of acting, or of appearance; but, as men come to learn more of the qualities and relations of such object, the name gradually loses its descriptive value, and becomes a mere symbol or word counter for the total content of the concept. Thus, "the Russian called the duck *utka* because he saw it plunge its beak into the water; the Pole called it *kaczka*, because he noticed that it waddled in walking; the Bosnian gave it the name of *plovka*, because he saw it swimming"; yet in their survival none of these terms for the duck retain or even suggest the character which originally gave rise to them—they imply the duck in all its characters and activities. It is for like reason that the various symbol values of a vast number of terms in our own language have gradually emerged from their original meaning as words descriptive of a single quality of the thing named—sheep from "bleater," its original meaning; dawn from "shine," pig from "grunter," or "the maker of the *su* sound," mortality from "a wasting away," mother from "fashioner," sky from "cover," mouse from "stealer," ant from "swarmer," bird from "upstriver," father from "nourisher" or "protector," ground from "the trodden," foot from "treader," woman from "bearer" (*gune*), "soft one" (*mulier*), or "the suckler" (*femina*), night from "the blind" or "dangerous," earth from "the dry" (*terra*), house from the "built," horse from "the neigher," picture from "scratching," stars from "strewn," fetters from "footers," fingers from "seizers" (*Fänger*), language from "tongue," imply from "folding in," apprehend from "taking hold of," develop from "unwrap." The gain of the process is obviously this—that the mind, instead of describing a single quality by its name—instead of having to deal with all the qualities separately—is enabled to include in a single concept all the characters which the thing named is known to possess, and to bring such concept into true relation with other concepts equally rich in the number of qualities which they connote. That the economy thus attained is no small one—that it means enlargement and perfection of end as well as saving of energy—may be realized by remembering the enormous increase which has taken place even in recent years in the meaning of such simple terms, for example, as stone and star. "Stone," to the uncultured man, is merely a hard substance of a particular color, size, shape, and weight; to the geologist the concept "stone" has a rich content of both chemical and physical characters, and demands for its thorough comprehension a familiarity with the whole history of the planet. So to the ignorant man "stars" are little more than

> specks of tinsel fixed in heaven,
> To light the midnights of his native town;

while to the educated, and above all to the scientific mind, the concept is rich with thoughts of cosmic processes and solar evolution, and has a content of materials drawn from well-nigh every department of knowledge.

Economy in language (which throughout implies economy in mental processes) is probably shown as much by that which escapes as by that which attains to expression in speech. Words are brought into use only to describe things, actions, and relations that are of habitual or frequent occurrence. A vast number of phenomena are left unnamed for the reason that they do not recur with sufficient frequency to demand formal attention for the social purposes of language. Thus, if only one railway collision had ever occurred, the word "telescoped" would never have been invented; so a single case of "marauding" or of "boycotting" would have been totally insufficient to bring into existence these now familiar terms. It is because most emotional states are too complex ever to recur a second time in the same form and sequence that they can never become fixed by language, and that the feelings excited by the sight of a beautiful landscape, or an Alpine range, may be but imperfectly suggested only by the multitudinous epithets of a poem, and need a new poem to suggest them every time they are felt. The naming faculty is in fact called into action only as impressions emerge into familiarity: for the changing complex of the activities and relations that never recur twice in the same way, and often never recur at all, the mind has no process of classification, and therefore no concepts that can be named.

Uttered speech is full of the signs of this ever-present striving after economy. Observe the constant omission of particles and words whenever intelligibility is to be attained without them. Where gestures will suffice to convey our meaning—a beck of the hand, it may be, or a shrug of the shoulders—we do not need speech, or, when we do, a "Pooh-pooh!" a "Mind!" or a "Beware!" will often answer all our purposes. We say "in French" for "in the French language"; "Thanks!" for "I thank you"; "Herein!" for "Kommen Sie herein!" In phrases like "I go to-morrow, not you," "Ni l'or ni la grandeur ne nous rendent heureux," "Dove ci è despotismo, non ci è virtù" (Gaetano Filangieri), "Er war ärmlich, aber doch sauber gekleidet," "Me ipsum ames oportet, non mea" (Cicero), we habitually omit words formally necessary to the sentence, but not needed to convey its meaning. As, moreover, words are dropped from phrases, so letters are dropped from words. When there is no literature to stereotype a form, as in the case of the native American languages, degeneration by process of syncope sets in rapidly; it is not delayed long even for classic tongues, like Greek and Latin, or for their successors of the Romance family, on all of which phonetic decay has set its mark; while all literary tongues, ancient and modern, display the process in their colloquial forms. Thus the process which turned *anima* into *âme*, *femina* into *femme*, and *punctum* into *point*, which converted the earlier Latin *ad diem* into the later Latin of *ad die*, and in Italian shortened *de ab illo monte* into *dal monte*, has its analogue in the Bas-Valais peasant's contraction of *gênisse* into *j'ni* and *éteindre* into *tède*; in the Berlin workman's conversion of "*Ich*" into "*I'*"; in the English reduction of "I love-did" to "I loved," "boatswain" to "bos'n," "God be with you!" to "Good-by!" and in the slang which in portions of the United States has begun to dwarf "How do you do?" into "Howdy?"

There is abundant scope for economy in all the forms of literary expression. Not only do we avoid as far as possible redundant elements, we also choose words calculated to convey our meaning with the minimum of effort on the part of the reader or listener. Where our end is simply that of intelligibility, as in the case of scientific statement, we choose words as simple and as expressive as possible; where to the end of intelligibility are added the ends of style, we employ words more ornate and picturesque in their character. In most prose compositions we are satisfied if we succeed in conveying our meaning; in most poetical compositions we seek, in addition to the end of intelligibility, to produce emotional excitement, to call the imagination into powerful activity, and to give rise to various pleasing effects, such as those of rhyme and alliteration. But whatever are our ends in composition, and however multifarious they may be, we always strive to reach them in the completest way and with the least possible demand upon the attention of the persons whom we are addressing. The sparing use of metaphor and parenthesis, the placing of the stronger epithets after instead of before the weaker, the avoidance of long and involved sentences, the care taken not to repeat words already used instead of their synonyms, the provision for variety which excludes monotony both of thought and of style, the observance of a best arrangement for the words in a sentence, the choice of particular material for the various paragraphs of a composition, and the construction of the links by which unity is secured for the whole treatment—all this is ordered, as far as is possible in each individual case, so as to produce a maximum of effect with a minimum of material.

How intolerant men are of speech elements unnecessary to intelligibility is shown by the drift of the educated and uneducated alike toward a phonetic spelling by the gradual doing away with inversion in both word and sentence, and by the growing tendency to use adjectives as adverbs, to discard subtleties like the subjunctive, and break down the well-established distinction between "shall" and "will." The economy which has taken place in the domain of grammatical forms is shown both in their gradual acquirement as means to the increased intelligibility of speech, and in the haste with which the mind, no longer needing them, hastened to discard the scaffolding of the structure which with their aid it had built up. The enormous gain which has been secured by the dropping of inflection may be appreciated somewhat by reference to the clumsy paraphernalia of such undeveloped languages as Zulu, in which, as translated by Dr. Bleek, the simple sentence, "Our great kingdom appears; we love it," must be expressed as, "The kingdom our dom, which dom is the great dom, the dom appears, we love the dom" (*U-bu-kosi b-etu o·bu-kulu bu-ya-bonakala si·bu-tanda*). So the saving attained in such a language as English may be easily inferred from the wild luxuriance in analytic distinctions of all tongues in an early stage of development.

It should be added that the gain which comes of the gradual rejection of inflection is a gain not merely in the domain of language alone, it is throughout made possible by mental ascent, and the whole of the progress which it implies is a progress not only in the saving of labor in the intercourse between men, but also in the enlargement and perfection of the ends of that intercourse.

We now return from this brief and highly incomplete account of the various forms of acting to consider the application of our principle to the case of the organic system. That principle admitted, it will be at once obvious that the law of least resistance must be true of all those rearrangements and activities which are imposed upon a living protoplasmic system in the interest of maintenance. If, in other words, such aggregate be impelled by the forces inherent in organic molecules to maintain itself, the various means by which it will maintain itself will be means such as, from the minutest detail of structural rearrangement to the highest organ and process, are best adapted under the whole of the circumstances to accomplish the end of maintenance with the minimum expenditure of energy, and this for the reason that only such means can arise by movement in the direction of the least resistance. It also follows, from the inevitableness of the law and from the character of the organic aggregate as a system of parts, that the means by which maintenance is carried on by such aggregate will undergo progressive improvement, and will therefore illustrate the same gradual advance in the economizing of energy and the perfecting of end as those which are exemplified in the ascent of the human community.

The obvious analogy between the parts of an organic system and the individuals constituting a human society is completely borne out on examination. Whether, in fact, the primitive organic aggregate be viewed as a union of previously separated units, or as an organic mass divided into unit parts that are first likes to each other and only finally differentiated, or as an aggregate that undergoes differentiation of its parts the moment it is sufficiently advanced in complexity to possess organic character, the fact remains that the parts can not constitute an organic system without aiding each other in the work of maintenance. Even if we could regard them as independent of each other, though associated, we should be compelled to say that, acting in accordance with the law of least resistance, they would find it easier to divide that work among their own number than for each to maintain itself apart from the rest. Yet the reality is even stronger than this: since the parts are interdependent, must each act in the interest of the whole of them, and are each by that whole dominated, so to speak, into co-operation with one another for the ends of maintenance. Just in proportion, moreover, as special activities are imposed upon special parts, in that degree are such parts differentiated for the tasks they must perform; special centers and organs arise connecting the various processes with one another, until finally the whole unified system is an aggregate of co-operating but subordinated individualities, of which each is in the service of all, and all act in the interest of each—an aggregate, that is to say, in which each of the parts, instead of having to carry on itself all the activities of maintenance, obtains in exchange for its own small contribution to the general labor the services and power of the whole society. In other words, the parts of such a system, impelled to the activities of maintenance, move into those configurations in which self-maintenance is the easiest and completest for all of them, and do so by a process of gradual adaptation and interadaptation, every stage of which is a stage of increasing efficiency of end and of greater economy of energy in the reaching of that end.

The progressive unification of men in the human society also has its analogy in the progressive unification of the organic system. In the lower planes of life lack of complete solidarity between all the parts and processes of an organism often manifests itself in the well-known phenomenon of iterated organs. The system in this stage consists, so to speak, of groups or segments, and every segment has its special set of organs—such, for example, as the legs of the centiped and the lobster, the multiple breathing holes of insects, and in a variety of organisms the iterated eyes or ocelli, as well as the repeated nerve centers of many of the lower forms. As the organism becomes unified this phenomenon of iteration tends to pass away, and the change is wrought through what may be called the discovery by the organism that it is easier to produce and maintain a single set of organs of each kind for the body as a whole than to produce and maintain and use a separate set of such organs for each segment or group. Hence the ascent of the organism from the stage of iterated organs to the stage of single sets of organs, from the condition of imperfect to the condition of perfect unification, is ascent by diminution of resistance, by perfection of end, by greater economy of energy.

As, moreover, the improvement of tools is a saving of energy to the individual wielding them, so is the improvement of an organ to the system which needs and has produced it for ends of maintenance. In the degree that the organic parts have special activities imposed upon them, in that degree do they become modified by those activities, and therefore adapted to the doing of those activities. An incipient leg, tail, fin, or eye, or any other organ, impelled to a particular thing, to act in a particular way, will do that thing more perfectly, will act in that way more completely and efficiently, with every repetition of the acting, for the reason that the parts of the organ and of the organism become with every such repetition, up to a certain natural limit, more and more adapted to the doing of that particular thing, to acting in that particular way; and this is why use is said to improve organs. The parts of such a system rearrange themselves in such a way as in every case continually to lessen the resistance offered within the system to the acting needed for each particular end. Just as from the simple foot of the snail to the leg of the vertebrates, so from the membrane of the worm sensitive to light, from the ocelli of insects and marine organisms to the highly developed eye of mammals, or from the incipient forms of internal organs to the more perfect and efficient forms of such organs, there have been progressive stages of ascent in the economy of energy with which given ends have been reached, as well as improvement of the ends themselves. In the case of organs, as in that of tools, the improvement has been made possible by a finer sense on the parts of the organism acting of the direction of least resistance, a finer self-adaptation by that organism to the environment, and a more perfect reaching of more perfect ends as the result of that adaptation.

We now see that the advantage gained by the perfection of any given organ or appliance necessary to maintenance is the advantage which, given the end to be reached, is gained by the saving of energy in the reaching of that end—that, in other words, the inducement to the improvement of any given organ is the saving of the energy spent in reaching, with the aid of that organ, the general end of maintenance. The more perfect are the appliances of the organic system, the more easily and completely does that system reach its end of maintenance; hence the gradual improvement of the organs with which maintenance is accomplished is so much movement in the direction of the least resistance. Thus the eye is gradually perfected in successive organisms, not because there is anywhere any foreknowledge that a given configuration of parts will lead to so highly useful an appliance as the organ of vision, but because, given the impulsion to maintenance and the general conditions of organic life, all structural changes leading away from the development of an organ like the eye would involve loss of energy to the organism in the reaching of the general end, and because all rearrangements of the organic parts that lead directly to the development of the eye are favored, as against rearrangements tending in any other direction, by the fact that every successive stage of such rearrangements results in a saving of energy in the reaching of maintenance to the organism bringing them about. In a word, the path of structural movement toward the eye is the easiest path, the path of least resistance, while the path away from the eye is the most difficult path, the path of greatest resistance; and what is true of the eye is true of all other organs and organic appliances whatsoever. Given, therefore, the molecular forces which in some way not yet understood impel the organism to display those activities of maintenance which we call life, and there follow, by virtue of those forces, of the character of organic matter, and of the general conditions of existence, not only the intelligent adaptations which make possible and facilitate maintenance, but also the gradual improvement of those adaptations which constitutes organic ascent.

What, finally, is the outcome? In the biological world at the present moment the great question which interests inquirers is that of the meaning of intelligent adaptations. Thinkers in this field no longer question the existence of intelligence in the unconscious form; they seek to discover what that intelligence means. "What we should like to discover," says one of them in a letter to the writer, "is the seat of the so-called unconscious intelligence which brings about those structures which the older teleologists called designed." That natural selection supplies little if any material for an answer to the question is already recognized. It being impossible to trace these structures to an artificer operating outside, our only recourse is to look to the organism itself for the power to which the fashioning of tissues and organs is due. And though we can do nothing toward solving the fundamental problem in biology, the origin of life itself, we need not despair—given the fact of life—taking the powers of living protoplasm for granted, of comprehending something of the process by which intelligent adaptations arise. For, the rest being assumed, we see how from the operation of the law of least resistance all the mechanisms of life result by necessity. Writ minutely in the tissues of the organism the law is inscribed broadly and grandly on all the features of our modern civilization. Not an activity of the busy industrial life around us, whether it be due directly to travail of brain or hand, or find its realization in that wonderful, external side of human life—the life of machinery—but illustrates the universal mode in which all conscious intelligence reaches its end. And so also in the realm of the unconscious we have only to take for granted the powers of living protoplasm, and the simplicity as well as the exceeding beauty of the process by which intelligent adaptations come into existence flash upon us like a revelation. We look as with vision renewed upon the pine cone in the forest, upon the flower shining amid the expanse of green, upon the sudden lightning of the firefly, and the manifold hues of insect and bird. For, little as we have attended to them before save as the commonplaces of our knowledge, we now see that they are paths of least resistance objectively embodied—protoplasmic tools with which, in the silence of the unconscious world the organic system is slowly but surely reaching its ends. And as we ponder it becomes clear to us that the same system is at work in the making of tools and the fashioning of organs—that, though the one process is conscious, the other unconscious, they are deep down in the heart of them the expressions of but a single method. Everywhere we find the evidences of this likeness —in the awl of the shoemaker and the tool of the boring insect; the earth-trap of the native African and the pitfall of the ant lion; the web of the spider and the net of the fisherman; the digging stick of the Australian, the foot of the mole, and the spade of the navvy; in the single oar of the boatman and the sculling tail of the fish; the sticky tongue of the anteater and the slime pot of the human catcher of birds; in the kayak of the savage and the floating pupa skin of the gnat; the scale armor of the armadillo and the soldier's cuirass; in the climbing hooks of the tiger beetle, the claws of the bat, and the grappling irons used in naval warfare; on the one hand, in the pulley, screw, and wedge; in chisels used in stonecutting, gravers with which wood is carved, axes for felling trees; in screwdrivers, lifting jacks, Nasmyth hammers, battering rams; the cord and weight of the window sash, the wheels of carriages, and the rollers whereon heavy masses are moved from place to place; on the other hand, in the muscles, sinews, and joints of animals; in the wing of the bird, the paddle of the porpoise, the hand of man, the mandible of the ant, the horns of the cow, the lance of the swordfish, the stinging cells of certain cœlenterata, the channeled poison tooth of the snake, or the defensive antennæ of the spider; even in the vertebrate eye itself. For all these, being objective paths of least resistance, are signs of a law that, pervading the realm of living things, has its roots in the inorganic world, since it springs from the very nature of motion as a result of differential stress. And when adequate account is taken of the presence of end in organic activities, of its absence from movements which are inorganic—account, that is to say, of the fundamental difference between living protoplasm and inorganic matter—then the whole of evolution, viewed apart from its secondary processes, may be summed up in the simple formula—movement in the direction of least resistance.

LET US THEREWITH BE CONTENT.

By ELLEN COIT ELLIOTT.

THE men of America have met the suffrage agitation with an admirable gallantry. Aspersed to their faces from the rostrum as masculine creatures of unfathomable iniquity, they return only a deprecating smile. Assured by the "new woman" that the ever feminine leadeth them on, and that politics will clarify as soon as the superior purity and integrity of the sex are brought to bear upon them, they appreciate her splendid confidence, applaud, and cry her on. There are those who, ever suspicious of the masculine character, take umbrage at this favor, looking upon it as an impertinent condescension. But surely we may grant that the slow partner of our humanity, admiring our victorious advance, and bewildered by our swift onslaughts from all points at once, wishes by his expressions of good will to placate our wrath and further our desires. Stupid and mannish he may be, but after all he is rather good-natured.

American women, however, are taking toward the question at issue a curious attitude. One large and picturesque division, when exhorted that they "ought" to desire a finger in the political pie, if not for the sake of the pie at least for the sake of the finger, show a sweet resignation, and, definitely premising that they do not wish the ballot, cry meekly that if it be the will of God to give it to them they will do their best to make a proper use of it. Others express a frank impatience with our prophets and saviors. Others, still, recognizing that the vantage ground upon which American women stand to-day is not entirely the result of democracy, give due gratitude and appreciation to those who through hard battles have helped to win the position. "But," they exclaim, "stay in your ministrations of deliverance! Forbear to impose upon us the added responsibility of the suffrage!" And, worst of all, masses of these shackled citizens show an unalterable apathy toward the injustice they are suffering, and indifference to the hands reached out to help them. Surely never did enthusiasts have to deal with more refractory and exasperating material. The suffrage leaders have proved in their own persons the angelic quality of womankind in not giving up long ago the attempt to free such inveterate slaves.

What is the significance of this general reluctance? To give her the suffrage is to add another to the long list of her opportunities for exercising power and influence outside of the home, and the question becomes, Do American women desire this, and if not, why not? The answer is bound up with the hackneyed subject of "woman's sphere," and, as all our philosophy is nowadays biologized, it rests back upon the great physical fact that women for all time must be prepared to bear and rear the children of the race. Granting that much of her physical disability is due to various sorts of foolishness and may be removed, it remains undeniable that in even the most normal of women the reproductive system is by nature so constituted that it requires a much larger proportion of her vitality than is the case with man. Hence, leaving out of account all other possible variations between the sexes, this difference alone is a definite handicap to all women who "compete" with men. For married women there is the further fact that childbearing and the care of children add a new and very serious handicap in any "competition" with men.

If, then, woman is physically at so great a disadvantage in many occupations, shall she not consider that these occupations are, for her, but secondary issues? For her specialty shall she not look along the line of least resistance? Instead of denying her physical constitution, shall she not exalt it by a consistent allegiance to its fundamental significance? Notwithstanding the present apotheosis of the physical sciences, woman will not rest satisfied in a purely physical explanation of her destiny. Bitter rebellion is inevitable whenever she is confronted by her physical limitations and possesses not the spiritual key to their meaning. But a spiritual significance in the life of woman has been more or less felt in all times, and in the present it is not only tacitly conceded by society in general, but it has received definite scientific formulation. From their physical constitution women more than men must inevitably sacrifice themselves for the progress of the race. Unconscious and unwilling though they may have been, necessity and habit have so trained countless generations of women in the practice of self-denial that they have grown to be in the world the special witnesses and exemplifiers of the altruistic principle. So true is it that motherhood and the love and self-sacrifice which it involves, is woman's peculiar contribution to evolution and progress, that, as has been keenly pointed out, "the woman question is not solved until it is solved by mothers." In other words, a woman can not solve her life problem on a purely individual basis except at the price of her influence on the race. A man may lead a life largely self-centered and still transmit his qualities to his children, but the self-centered woman can not pass on her qualities, for she will have no children to inherit them. If she would, in any large way, save her life, she must lose it.

The actual facts bear out this conception of a woman's function. It is not that women are wholly altruistic. Though loath to own it, we are but mortal. Nor will any (except the suffrage leaders) contend that every woman is more unselfish than every man. On the contrary, it is only too easy to point out cases where feminine selfishness is shown again and again in petty ways to which men, as a rule, do not stoop. Yet it remains in general true that the practical life of women the world over calls for a more constant exercise of self-sacrifice than that of men, and that everywhere women have learned in the main to make their sacrifices cheerfully because lovingly, and even to court a life which brings them. That this acquiescence should be often considered an indication of tameness, if not inferiority, is but natural in a civilization which has even now only half realized the dignity of the altruistic ideal. In the affairs of life intellect has enjoyed a long prestige. Character, which, according to the highest conceptions of the race, depends at its best upon altruism, is but slowly growing into an equal recognition. In a rough, general way, men have been the apostles of the one and women of the other. It is true that the ideal of humanity is one. Women have gained in intellect and men in character, and this must go on; but it has not come about, and it will not come about, by a direct exchange of their activities.

These considerations lead to the good old dictum that "home is woman's sphere." It seems well-nigh superfluous to enumerate the obvious qualifications of this general statement. Surely no *fin-de-siècle* person would understand it to mean that woman should look upon marriage in itself as the sole desideratum of her existence, or that, failing to marry, she should devote herself to pets and fancy work, and live upon the charity of her male relatives. Surely at this stage of proceedings no one would attempt or desire to limit woman to purely domestic pursuits. It has been reiterated and most abundantly proved that she need not be circumscribed in freedom or opportunity for the sake of binding her to the home: it is not necessary, for Nature will take care of itself; and it is not expedient, for the more she is allowed to be in herself the greater the gift she can and will bring to the race. Moreover, no one will contend that every woman ought to be a mother, or that an indefinite number of offspring is a wife's chief duty. In a word, marriage, and the bearing and not bearing of children, are individual accidents dependent upon a thousand private considerations. To fulfill the law of womanhood one need not be a mother, but only to be motherly; one need not be a wife, but only to be loyal to the unselfish principle of wifehood; one need not eschew the paths of business or professional life, so only that she recognize hers as the exceptional feminine career, the more normal and significant one lying within the walls of the home.

Consciously sometimes, but perhaps more often with unconscious instinct, a woman does thus stand by her colors. Why this eager activity in the matter of temperance rather than the tariff? Because intemperance menaces the home. Why this quick sympathy with organized or unorganized charities, as opposed to the average apathy over finance? Because charity touches people whom she can love and homes which she can transfigure. And—if one may be pardoned a notion somewhat transcendental—is not her oft-observed lack of creative ability, together with her equally notable power of appreciation, due to the fact that with her an idea is not worked out so readily in purely intellectual formulations as in the material of character? The laws of mechanics as such she does not readily apprehend, but the truths of rectitude which are their moral counterpart she grasps with special illumination. The masterpieces of formal art she does not create, but she, more naturally than man, can live a life which may properly be called a poem or a picture.

And why this respect for womankind deeply rooted in the best of men? The individual character of woman is not, unfortunately, so much loftier than that of man as to compel it, and that she is the "weaker sex" hardly accounts for so large a fact. Nor does it look like a merely left-over remnant of mediæval chivalry. Is it not, at bottom, that sound and sensible men recognize and reverence the altruistic ideal, which, however faltering her loyalty, it is a woman's special privilege to perpetuate? The beautiful phrase so bedraggled by controversy—

> Das Ewig-Weibliche
> Zieht uns hinan—

does it not mean that the principle of love which rules a woman's life is also the loadstar of human progress?

Homes must be made, and the masculine half of us, as they make haste to proclaim with amusing emphasis, have neither the inclination nor the ability to assume the task. Says one of them, naively, "If marriage meant to a man what it does to a woman in the way of suffering, labor, and social status, I am convinced that not one man in fifty would marry." It is impossible not to be reminded of the similar disclaimer—

> Oh, then I can't marry you, my pretty maid!

and the milkmaid's retort—

> Nobody asked you to, sir, she said—

seems singularly appropriate, did we wish to be so impolite as to use it. But, strange as it may look to the masculine mind, women in general do choose to marry. They are not driven to it by the conditions of society, nor impelled by a blind sexual instinct, nor misled by the enthusiasm of the martyr. They know perfectly well what it will mean in their career. And they need not be looked upon as fools for so doing, being in fact possessed of the average degree of common sense of the race. They choose it because they want it, and they want it because, in spite of its restrictions, it brings the most satisfactory fulfillment of their aspirations and development of their powers.

The same masculine thinker is firmly convinced that "women wish to be men, but men do not wish to be women." Both parts of this proposition are delightfully characteristic of the sex which has never been backward in claiming its superiority, and the last clause, by the same sign, is doubtless unquestionable. But the first is as unjust to woman's ideals as it is derogatory to her mission. If she give up social pleasures, literary activity, pecuniary independence, or a hundred other personal ambitions, to minister to the interests of one modest home, and the career of one average husband; if she turn from the gratification of public recognition to years of the unapplauded cares of the nursery; if she drop out of the onward march of purely intellectual progress, and spend her life marking time in the ranks of the housekeeper—it is not because she is the poor-spirited victim of circumstances. It is not that one half the race is, by some mischance of destiny, doomed to a life of tragedy. The bird with one wing broken droops in its flight, and humanity thus hampered would have sorely lagged in its onward sweep. On the contrary, she chooses these things because law and the satisfaction of her life are not that of individual ambition or attainment, but the law of love and service—"unto the Jews a stumbling-block and unto the Greeks foolishness."

Women, it is true, do not always feel or admit this. Many of them have a taste for pity, and they pet and pity themselves and each other. Yet the more sincere own willingly that everything has its price, and that they have paid none too dear for that which they have gained by their sacrifice. The strongest scorn to pose as martyrs, because they see clearly that in life as it runs, a woman, exactly as a man, gets what she pays for, and must pay for what she gets. And they conceive of no more just equality of the sexes than this.

As to the women of America, to begin with, they are not, as some would have us think, downtrodden drudges, manacled slaves, or what not, after the same order. Rejoicing in the most perfect social freedom the world has seen, proud in a position and influence quite equal to those of men, they can afford to laugh at such tirades. With the exceptions that must always accompany general statements, woman in America may do whatever she wishes to do. She may run the typewriter in an office instead of a sewing machine at home. She may carry on a farm or a business. She may teach, write, preach, lecture, practice law or medicine. Journalism and *belles-lettres* are her happy hunting grounds. She may marry or remain unmarried with equal honor, and no one dictates in her choice of a husband. She may wear bloomers and ride a wheel. She may carry on public agitations to an unlimited extent. The most serious drawbacks to her complete freedom result from flaws in her own standards and traditions, and are in no wise imposed upon her from without.

American men are neither tyrannical nor condescending toward women. From childhood up they have been in the habit of seeing their sisters walk beside them with independence and privilege equal to their own. Their attitude is one of frank comradery based upon a respect which on both sides is unconsciously taken for granted. They have, besides, a genial tendency to be proud of their women and to applaud rather than discourage their ambitions. If women wish to vote, these men will not deny them. In fact, many an American household presents the edifying spectacle of a husband more ready to vote the suffrage to his wife than she to accept it.

Notwithstanding this freedom—perhaps because of it—one need only obtain an unaffected expression of their feeling to find that, maid and matron alike, the women of the country are, as a rule, content in marriage as a career. They wish for children, and gladly make the prolonged sacrifices necessary to their care and education. One day a young woman—exactly such a one as may be met with any day anywhere in the country—went "in fun" to consult a fortune-teller. But she returned in tears, and confided to her girl friend that she wept because the seer had told her she would never have children.

It can not of course be said that among women there is no discontent, no restlessness. The age is full of discontent of a certain kind, and restlessness is in the blood. Women do not escape these general influences of the time. Moreover, there is, at least among college women, a special dissatisfaction with the drudgery attendant upon home-making. With the increase of individuality which the higher education can not fail to bring, comes the need of a new sort of home; and the conflict and adjustment of old with new ideals, old with new duties, old with new purposes, brings confusion and sadness into the problem of many a modern woman's life. Notwithstanding this, the college woman is found in general to be no more ready than her uneducated sister to go back upon the womanhood which means self-denial, and the career which means self-sacrifice.

When these American women, full of the complicated interests and duties of the American home and its dependent sociological activities, are confronted with the prospect of exercising the suffrage, their instinct seems to be to draw back. Ask the women, one after another, in a representative community, if they wish to vote, and again and again will come the answers: "I haven't time," "My hands are overfull now," "How can I undertake a duty which means that I must inform myself upon all the public questions of the day?" Naturally, many of them, especially those who are temperance workers, or those whose property interests are not represented under existing conditions, desire the ballot. But the great majority are content to occupy themselves with the multitude of interests which are already theirs, and to leave the formal affairs of state to men. The great majority, when they speak sincerely, will say that home-making and its allied interests is their chosen life, and that its demands are so exacting that they must leave the work of government to other hands.

This attitude is certainly open to criticism. Perhaps it is true that the sons could be better educated by mothers who voted, that homes could be better made and protected by wives who held the power of the ballot, that the welfare of schools and charities would be furthered if women who are interested in them had a share in the making of the laws. Yet it would seem that if woman possessed by nature any great aptitude for political life, she would be eager to exercise it. It has been said that "the men are not what they are because they vote, but they vote because they are what they are." They make politics, and they are interested in the work of their hands. Women do not make it and (always in general) are not interested in it. If woman alone were to govern the state, how radically different would be her methods! And how can oil and water mix? Until she can disfranchise man and establish a rule of her own peculiar sort, woman may perhaps be expected to show indifference to political affairs. Furthermore, she might evince more alacrity for reaching out for the august power of the ballot if she observed that the men who exercise it thereby get what they want. But to her puzzled query, "If you want this reform or that measure, why don't you put it through?" the conclusive reply is that "you can't get at it," on account of the "primaries," or "the bosses," or "the spoils system," or the "rings," or the wheels within wheels of whatever other complications interfere to muddle the brain and thwart the will of the sovereign American people. A woman answered thus, and reflecting upon the suffrage, is apt to wonder, in her silly, feminine way, if the game is worth the candle.

Perhaps it is worth the candle. Many a wise man thinks so, and having the suffrage himself, a man should be able to estimate its value. However that question may be finally settled, women will be women. The practical conviction that this is after all what they most wish to be must have an important bearing upon their particular aspirations, and it is this conviction which, to say the least, suggests misgivings and compels reserve in the minds of a very large number of average American women whose voices are not heard in the land.

WILD FLOWERS OF THE CALIFORNIA ALPS.

By Miss B. F. HERRICK.

THE Sierra Nevada mountain range—with its lofty, snow-capped peaks and majestic glaciers, its serrated crags and romantic cañons, its foaming rivers, sparkling waterfalls, and dense pine forests—is the California Switzerland. The climate of this region more nearly resembles that of the mountains of the Atlantic coast than any other section of the far West; and the vegetation is in most respects quite similar, though there are many varieties of trees and plants that are peculiar to the State. Spring is late in these high altitudes, and the summers are of all too short duration.

Among the first flowers to greet the new year is the curious snow plant (*Sarcodes sanguinea*), world-renowned not only from the fact that it is exclusively Californian, but on account of its rare beauty and individuality. It was first discovered by one of General Fremont's exploring expeditions on the slopes inclosing the valley of the Sacramento; and is common at the Yosemite and on Mount Shasta, at an altitude of from four to nine thousand feet above the sea level. Though generally supposed to be parasitic on the roots of the pine tree, eminent botanists, after careful investigation, now claim it to be a "saprophyte," or a plant growing from a rotten substance near the surface of the soil, like certain species of fungi, an aid to this conclusion having been found in the fact that the plants are sometimes known to flourish in open places considerably removed from any growth of timber. Their usual habitat is moist, sheltered forests, where the winter snows fall deeply; and they make their appearance when the spring sun warms the frozen ground and melts the fleecy snowdrifts. True leaves they have none; and the fleshy bracts, bell-shaped blossoms, and thick, brittle stems are all of a brilliant scarlet, icy to the touch, and of the consistence of crystallized sugar. The average height is about one foot, what corresponds to the underground roots or bulbs being of about an equal depth and of a much lighter tint.

These plants are members of a suborder of the heath family;

A Glimpse of the California Alps. Mount Shasta in the distance.

though their resemblance to the sturdy manzanita, the fragrant rhododendron, or the velvet-limbed madrone is not at first apparent. They abound in gallic acid, giving them a sour smell, suggestive of ink or vinegar. In early summer the flowers are succeeded by hard, circular pods, containing numerous fine seeds like those of a poppy; and despite repeated experiments in germination, they refuse to grow in a foreign environment. Transplanting also always meets with failure, though specimens may be dried and kept for several months. A writer in Hutching's Heart of the Sierras thus graphically describes this matchless Alpine flower:

> A pyramid of tiny tongues of flame,
> Darting from out the rifts of dazzling white;
> A strange bright phantom, born of ice and fire,
> Flushing pale wastes with gleams of crimson light.

On the bleak, ice-bound heights, at an altitude of from eight to twelve thousand feet, is found the curious "red snow," a very low form of vegetable life, which, though common in polar regions, occurs in the United States only on Mount Shasta and at the head of Cross Creek, Colorado. When it is trodden upon in a half-melted state, the footsteps of the mountain-climber fill in with a clear, blood-red fluid, which leaves no stain, even if examined in the handkerchief. Some of the patches are of considerable size, while others are scarcely a foot in diameter; and the color varies from a deep magenta to the faintest shade of pink.

Rivaling the snow plant in general interest is the singular *Darlingtonia*, or California pitcher-plant, indigenous to open, marshy places in the northern part of the State from Mount Shasta to the coast, and the only species of its genus, though it is related to the Eastern *Sarracenias*, or side-saddle flowers. The pitchers, which are said to be in reality the enlarged and hollowed petioles, or leaf stalks, average about three feet in height, and are terminated by an arching hood or crest, furnished with a pair of mustachelike appendages, which are the genuine leaves. As these are provided on the under side with numerous honey glands, and are usually highly colored, they constitute the principal lure; though the cunningly devised, nodding flowers, conspicuously borne on the ends of long, bare peduncles, also contain an intoxicating nectar. The interior of the pitchers is lined with innumerable fine, downward-pointing hairs, which form a most insecure footing for the struggling victims and render escape almost an impossibility, while the glare through the lacy, domelike roof only adds to the general confusion.

The colorless liquid which half fills the tube must be secreted by the plant itself, as the covers of the pitchers prevent the accumulation of raindrops; and the insects ensnared are mainly winged varieties, such as flies, bees, wasps, and beetles, though ants, spiders, slugs, and other crawling creatures often share their untimely fate. In one of these omnivorous vegetable traps the writer once discovered a tuft of three straight pine needles, six inches in length, though how they ever worked their way, unbent, through the curved mouth, will ever remain an unsolved problem.

Intermingled with the pitcher plants and coarse grasses of the swamps is often found a tall, graceful orchid (*Habenaria leucostachys*), with spikes of small, white flowers, distilling the fragrance of the tropics; and in its company frequently grows the California *Cypripedium*, or "lady's slipper," which has leafy stems about two feet in height and from three to a dozen blossoms, with brownish, twisted petals, and a white lip veined with purple.

The rose-tinted, drooping *Calypso*, and the *Spiranthes*, or "ladies' tresses," are also lovers of wet places, the latter blooming in the late summer months and being easily recognizable by the curious manner in which the little, greenish-white flowers are coiled or twisted around the stem.

California Snow Plant.

Somewhat allied to the "ladies' tresses" is the "rattlesnake plantain" (*Goodyeara Menziesii*), the leaves of which were used by the Indians as sovereign cures for snake-bites. From the center of the variegated, rosettelike foliage springs a pubescent stalk, about a foot in height, bearing a spike of one-sided white flowers, which bloom in the deep woods through July and August.

The epipactus (*Epipactus gigantea*) is found in the tangled undergrowth along the banks of mountain streams, and has slender, leafy stems and from three to ten brown and green blossoms, marked with purple; while the *Listera*, or northern twayblade, may be distinguished by the stout oval leaves, clasping the low stem, and the downy raceme of tiny purplish flowers.

California Pitcher Plant.

None of the above-mentioned orchids are parasitic; but there are at least two indigenous species which draw their nourishment from other plants. One is the well-known "coral root" (*Corallorrhiza*), so called on account of the fleshy rootstocks, which resemble branches of white coral. There are several varieties, inhabiting dry spots in mountain forests all over the State. Both flowers and stems are of shaded browns and yellows, and the plants readily escape detection, as they are so nearly the color of the surrounding dry weeds and grasses.

The other parasitic orchid is the *Cephalanthera Oregana*, a northern species of especial interest, suggesting the "corpse plant" or "Indian pipe" of the Eastern woods. It is wholly destitute of green leaves, and the stems and flowers are of a pure glistening white, somewhat startling in their unique beauty. Like the epipactus, it prefers the neighborhood of forest streams and hides itself in the shrubbery.

All along the banks of the foaming Sacramento there grows, as though planted by a landscape gardener, the giant saxifrage (*Saxifraga peltata*), locally known as the "umbrella plant," and also as the "Indian's rhubarb," certain portions of the plant being edible. Its generic name signifies "rock-breaker," as it is said to disintegrate the rocks from the clefts of which it springs. The graceful stalks, often a yard in length, are terminated by scalloped, circular leaves a foot or more in diameter, which resemble small parasols or umbrellas inverted by the wind. Though highly attractive in the spring and summer, they are especially ornamental in the autumn, when their clear, green tints are changed to yellows and russets. The clusters of small pink and white blossoms, on the ends of the long, fleshy flower stalks, ripen in June into little double seed pods, which, when shaken in the hand or brushed against by accident, produce a sound much like that of the dreaded rattlesnake. Sometimes these plants domesticate themselves upon submerged rocks, the leaves floating on the surface of the current like those of a water lily, while the masses of tangled roots threaten to trip up heedless fishermen. Though many varieties of saxifrage are found in different parts of the State, none equal, either in size or picturesqueness, these beautiful border plants of the northern Sierra streams.

At irregular intervals along the banks grow tall thickets of fragrant azaleas, or rhododendrons, reflecting their bright green leaves and pink and cream-white flowers in the limpid water below; and behind them are terraces of feathery purple or white *ceanothus*, or mountain lilac, beloved by deer and honeybees.

Then come the dogwoods, flaunting their showy white bracts full fifteen feet in air, and mingling their spreading boughs with those of the laurel, the alder, the cottonwood, the wild hawthorn, and syringa. At their feet appear the freckled faces of the tawny tiger-lilies, the largest of which is the Humboldt, as tall as a good-sized man and with from four to six whorls of leaves, each whorl ten to twenty leaves in number; and rivaling them in attractiveness are the stately Washington lilies, with their satiny-white chalices, flecked with black and gold, suggestive of the Bermuda or Easter lilies of gardens and greenhouses.

GIANT SAXIFRAGE OF SACRAMENTO RIVER.

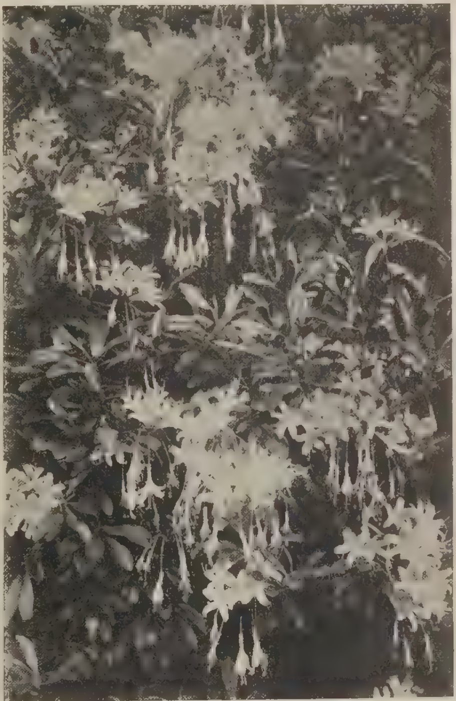
Among other lovers of moist localities are the *Aralia*, or wild sarsaparilla (the long, aromatic roots of which are sometimes used as a substitute for the genuine commercial article), and the poisonous *Cicuta*, or water hemlock, a member of the parsley family, easily distinguished by its lofty, hollow stem, large tripennate leaves, and umbels of numerous rays of small white flowers. On the borders of Lake Tahoe flourish the beautiful pond lilies, prized by boat-riders as trophies of summer excursions; the white *Brasenias*, or "water shields"; and the sulphur-yellow *Nuphars*, or "spatterdocks," the large flat leaves of which are the favorite camping ground for small green frogs. Most of the forest underbrush is composed of the manzanita, or "little apple" (*Arctostaphylos*), sometimes known as the "bear-berry," as Bruin feasts on the fruits. This shrub averages about five feet in height and has round, thick leaves and tiny white or rose-colored blossoms which ripen in early autumn into dull-red, globular berries, resembling Indian beads. The smooth, mahogany-hued bark peels annually, like that of the madrone; and the larger boughs furnish a hard cabinet wood capable of a fine polish.

Other flowering shrubs include the heathlike bryanthus; the *Audiberta*, or white sage; the rabbit brush, and the Oregon grape or holly-leaved barberry (*Berberis*), a low bush with prickly, polished foliage and racemes of yellow flowers, succeeded by round blue berries much like those of the elder. In great patches under the pines grow the *Chamobatia* (a little evergreen plant about a foot in height with blossoms like those of the strawberry), and the trailing *Vaccinium*, or "squaw's carpet," recognized by its small, serrated leaves, and round, pale-pink bells, or hard, reddish seed vessels. The Alpine phlox clings to the rocks in high altitudes, together with the arctic willow and dwarf conifers, while the juniper redeems barren, sandy sections from utter desolation.

Two pretty little wood plants, nestling in the dry leaves under the trees, are the *Pyrola*, or "shin-leaf," and the pipsissewa, or "prince's pine" (*Chimaphila*), the former having radical variegated leaves and nodding white flowers, suggesting those of the lily of the valley, and the latter being known by its shining evergreen foliage and terminal clusters of waxy, flesh-tinted blossoms of delicate fragrance.

Near by usually grow the quaint little "Dutchman's breeches," with their fine compound leaves and drooping, pink corollas, as well as the *Asarum*, or wild ginger, so called on account of the rootstock, which has a pungent flavor. This is an odd-looking herb, with several heart-shaped leaves, and a curious, brownish-purple flower, about the size of a large thimble, which makes its appearance just above the surface of the ground, and has no petals, but a three-parted calyx.

In open, rocky places one is apt to come across the downy, pink and white "pussy's paws" (*Spraguea umbellata*), together with clumps of gorgeous lupines—lilac, yellow, or rose-color—and patches of golden coreopsis, purple pentstemons, and lovely gilias, godetias, and Indian pinks; while tall columbines, larkspurs, and wild roses peep from the tangled shrubbery. The beautiful Mariposa lily, or "butterfly tulip," a member of the calochortus family, derives its name from the large dark spots on the petals and through June delights the eye with its yellow, violet, or snow-white chalices.


Azaleas.

In the early spring the wild flowers run riot everywhere, carpeting sunny, open spots with a veritable crazy quilt of bloom, chief among them being the large, purple-spotted *Nemophila*, or "baby-eyes," the white forget-me-not, the blue, white, and yellow violets, the wild agapanthus, the yellow iris, the wild strawberry blossom, and the far-famed *Eschscholtzia*, or California poppy, the emblem of the State. In these mountains there are a good many varieties of old-fashioned herbs, which have been used medicinally for ages, and are sacred to the memories of the spicy garrets of New England country farms. The chamomile and the aromatic peppermint and pennyroyal head the list; then come the aconite, or monk'shood, the flannely-leaved mullein, useful for lung troubles of man or beast, the woodsy yarrow, the yellow tansy, the wintergreen, and the *Brunella*, or self-heal—a cure for quinsy and all sorts of wounds.

On the outskirts of the Mount Shasta meadows, where the plowman stands knee deep in rolling billows of red clover, timothy, and redtop, there grows a singular floral torch, known as the California veratrum. This plant is a member of the lily family, and resembles the yucca or Spanish bayonet of the southern counties, the small, greenish-white flowers being borne in a dense panicle on the summit of a stout stem, from three to seven feet in height. The long, narrow leaves are smooth and grasslike, and are suggestive of corn or sugar cane. Close at hand, the spirea, or steeple-bush, waves high in air its feathery white or magenta plumes; and beyond are thickets of wild plums and hazelnuts, mingled with low bushes of thimbleberries, huckleberries, and large, prickly gooseberries.

Washington Lilies.

There are a number of roadside and pasture plants, known by farmers as "weeds," which nevertheless seem to have imbibed the very spirit of midsummer. Among them are included the dainty evening primose (*Enothera biennis*); the clematis, or "virgin's bower," festooning itself gracefully from tree to tree, with the wild grape and ivy; the milkweed (*Asclepias*), with its dull-pink flowers and big, oval seed pods, filled with brown seeds and silky white down; the yellow sunflower; the flame-colored *Castelleia*, or "Indian's paint brush"; the golden-rod, three to six feet in height; the aster, dandelion, and the bright-eyed little *Hypericum*, or "Saint John's-wort," formerly used in certain parts of Europe as a charm against evil spirits. In sandy places, on the edge of the woods, grows the curious "horsetail," or telescope reed, sometimes known as "file-grass," as the rough, furrowed stalks were once used for polishing purposes. Being without true or visible blossoms, this plant belongs with the ferns, mosses, and other cryptogams, and is said to have deteriorated from the coal ages.

Toward the end of September a change creeps over the face of Nature, and a solemn hush heralds the approach of autumn. The great, towering yew tree clothes itself with scarlet berries, and the dry, yellow leaves of the maple flutter downward through the quiet air, the chokecherry dons a robe of scarlet, and ripens clusters of astringent fruit of an equally vivid hue; the deciduous azaleas drop their foliage into the sparkling river, and the dogwood and poison oak assume a garb of solferino, while the continual dropping of pine cones breaks the silence of the mountain forest. Then the snow falls like a fleecy blanket, and winter sets in, with its rigors of ice and sleet.

THE PLANET SATURN.

By CLIFTON A. HOWES, S. B.

DOUBTLESS many observers of the sky are familiar with the planet Saturn as he slowly moves through the constellations from year to year, but how many of them stop to think of the wonders and mysteries connected with this far-off member of the solar system? Very few, probably; and yet this planet is well worth a closer acquaintance, for, as Prof. Langley says, "In all the heavens there is no more wonderful object than the planet Saturn, for it preserves to us an apparent type of the plan on which all the worlds were originally made."

Saturn was the remotest planet known to the ancients, and it was probably on account of his sluggish motion along the sky that a malignant influence over human affairs was attributed to him by the astrologers. This slow movement is only apparent, however, for he is really bowling along through space more than twenty thousand miles every hour; but such is his distance from us that we can scarcely detect any change of position from night to night, and must wait thirty years for him to make his circuit of the heavens.

In point of size Saturn stands next to Jupiter, the "giant of the solar system," and upon his diameter nine earths could be strung like beads on a wire, while from his vast bulk seven hundred planets like ours could be formed. But just here comes a factor which has an important bearing upon the present condition of Saturn. In spite of his enormous bulk, he "weighs" only ninety times as much as the earth, which at once shows us that the materials of which he is formed are much lighter than those composing our world. In fact they are but three quarters the weight of an equal amount of water, so that theoretically, if placed in an ocean large enough to hold it, this huge planet would *float* on the surface like a wooden ball.

There is but one conclusion from this and also from some other facts connected with the planet. Saturn is not, like the earth, a solid sphere covered with oceans and continents capable of supporting animal and vegetable life, but is midway between this state and that of the sun. In other words he might be called a *semi-sun*, perhaps giving forth but little light, yet so intensely heated still that its vast bulk is probably but a distended mass of liquid fire—a world where "the solid land as yet is not, and the foot could find no resting place." It is too bad to destroy the pleasant theories we often see about the inhabitants of this far-off world and the conditions of life upon its surface, but we can not evade the facts as they open up to us.

When viewed through a good telescope the planet presents a most beautiful sight—a huge golden ball, crossed by parallel belts of a brownish tinge, and capped at the poles with a bluish or greenish gray; and, most wonderful of all, surrounded by a thin, broad, flat ring, likewise of a golden hue. As if this were not enough, it is accompanied by a retinue of at least eight satellites or moons, some of which will be in the field of view.

Under very favorable conditions faint markings can be discerned on the belts, which seem in every way similar to those of Jupiter, and like his may safely be assumed to be masses of rolling clouds ranged in belts parallel to the equator by currents analogous to our trade winds. It seems very probable that these clouds may be mostly aqueous, and we may thus regard them as the future oceans of these planets, suspended in the air at present because the surface is not yet sufficiently cool to allow them to settle and remain as bodies of water upon it.

That this must be the case is shown by a moment's thought. We know that on the earth clouds are formed by the condensation, in the upper and cooler portions of the air, of the water vapor raised from the surface waters by the sun's heat. But at Saturn, nearly ten times farther away, this heat is reduced to one one-hundredth of its intensity here. On the earth too, as a rule, the clouds are somewhat sparsely distributed, so that a large part of the globe has usually fairly clear weather. On Saturn, however, we never yet have caught a glimpse, so far as known, of the real surface, whatever that surface may be. The rolling cloud masses completely envelop the planet and shut it out entirely from the sun's light.

We can scarcely suppose, then, that these clouds are raised upon this distant world by the solar heat, especially when we see how feeble that heat is compared with what the earth receives. And this is but another argument to prove the theory of Saturn's present condition as already given, for it is most probable that the planet holds in its own vast bulk the immense amount of heat whose presence is so certainly revealed in these phenomena.

Of course the rings are the unique and most wonderful feature of the whole system. When Galileo first turned his rude telescope upon Saturn, in 1610, he announced that the planet was *triple*, the projection of the ring on either side making it appear to him as if two smaller planets were joined to the larger one. Gradually, however, these smaller companions decreased in size and finally vanished altogether, much to Galileo's amazement. Later on they reappeared and still further increased his perplexity.

Saturn thus remained an enigma to astronomers until an increase in the power of telescopes brought out the fact that it was surrounded by a thin, flat ring, which, by its varying positions as seen from the earth, caused the peculiar appearances that so puzzled Galileo.

This so-called ring, when seen through large telescopes, appears as a very thin, flat disk with a circular opening in the center in which the planet itself is situated. It lies exactly in the plane of Saturn's equator, and extends considerably more than half the planet's diameter on either side of it. The breadth of the ring is just half the planet's diameter, so that there is quite a space left between its inner edge and the surface of the planet.

We speak of it as a ring, but in reality there are many of them. When favorably situated, a dark division can easily be detected which separates it into an "outer" and an "inner" bright ring; while within the last fifty years a third one, inside of the others, was discovered at Cambridge. This innermost of all, known as the "dark" or "*crêpe*" ring, is a most peculiar object. In appearance it is more like a shadow than anything else, for it seems to be semi-transparent, inasmuch as the outline of the planet can be seen *through* it where it crosses the planet's disk. It shades away gradually from the inner edge of the inner bright ring, and becomes fainter until it disappears at some nine thousand miles from the planet's surface.

What the nature of these rings may be is still in some degree a mystery. They are not gaseous, and it has been shown that they are not liquid, for no liquid could be suspended in such a manner without being precipitated eventually upon the surface of the planet. Nor are they solid; for it has been demonstrated that no solid could hold together under such strains, such tremendous forces, as the attraction of the monster planet would subject it to; it would soon be broken up entirely.

The only supposition remaining is that it is composed of myriads of solid particles—a ring of dust and fragments of rock and stone. In this case we may imagine it as being an immense swarm of tiny moons or satellites, each revolving in its own particular path around the planet, and the aggregation presenting to us at this distance the appearance of a solid mass. Of course, the word "tiny" must be taken in an astronomical sense, which would not preclude one of these "dust" particles or fragments from being as large as a house, or even a mountain.

That the ring is composed of solid matter of some kind is proved by the fact that it reflects the sunlight which it receives, apparently unchanged in quality, and deprives of sunlight those portions of the planet on which its shadow falls. But here comes the question, If we know the ring is composed of solid matter, how do we know that it is in the form of dust and fragments? This question was long a stumbling-block, but, as Prof. George Darwin points out, the investigations of M. Roche, a French mathematician, seem to have solved the difficulty.

Briefly, the reasoning is as follows: We know that our moon always keeps the same face toward the earth, but perhaps it is not so generally known that the cause of this is in the moon's own shape, which is that of an egg with the longer diameter pointing toward the earth. Not that this egg shape is so very pronounced, but it is sufficient to keep the moon from rotating as the earth does, and to keep its longer diameter pointed toward the seat of that force which holds our satellite in its path.

The cause of this egg shape is simply in what is termed the "tide-generating force." The moon's effect upon the earth due to this force is rendered noticeable and well known in our tides. The earth also exerts the same force upon the moon, only, as the former is eighty times more massive, the effect is correspondingly greater, and the moon's globe has suffered under the strain—has been pulled out of shape, so to speak.

Now this force of course increases as its source is approached, and were the moon brought nearer and nearer the earth, a point might finally be reached where the solid materials of which she is composed could no longer hold together, and her globe would be torn to pieces by the tremendous forces to which she would be subjected. To determine this point was the problem which M. Roche solved, and his conclusions led him to place it at a distance just under a diameter and a quarter from the planet's center. Within this distance, then, no satellite of any considerable size can circulate for the reasons above stated.

Now, the most remarkable fact remaining is that the outer edge of Saturn's ring system *lies just within this limit*, so that the conclusion as to its nature seems to point to the "meteoric theory," as it is called, as the only possible one. Either a satellite has been drawn within the fatal circle and disrupted, or the materials now present as a ring have been prevented from uniting to form a single satellite, as they might otherwise have done.

So much, then, for theory. The next point is, What proof can we get to substantiate it? This might seem at first a hopeless task, but that wonderful instrument, the spectroscope, has recently given us direct testimony on the subject.

One of the peculiarities of the spectroscope is its ability to detect the motion of a luminous body in the line of sight, by the shifting of the dark (Fraunhofer) lines of its spectrum from their normal position as seen in the spectrum of direct sunlight. Advantage was taken of this fact by Mr. J. E. Keeler, who obtained photographs of the spectrum of Saturn and its rings which plainly showed that the shifting of the lines due to the motion of the rings was greater in each case for the inner edge than for the outer, proving conclusively that the portions of the ring nearer the planet move faster than those farther away.

Let us see what this means. In the first place, if we suppose the rings to be solid, it is evident that they must rotate as a whole, the angular velocity of all parts being the same, but the linear or actual velocity being much greater at the outer edge of the ring than the inner, because of the greater circumference of the circle traveled over in rotation.

If, on the other hand, the ring is composed of separate particles, each in effect a little moon, it is apparent that the nearer these tiny satellites are to the planet the faster they must revolve to overcome the increasing pull of the planet and save themselves from being drawn to destruction upon its surface. In this case, therefore, the inner edge of the ring will have a much greater velocity than the outer.

Thus we see that the two theories require opposite conditions to obtain, and that the proof given by the spectroscope confirms directly the approximate correctness of the "meteoric theory."

This latter theory offers a ready explanation for the curious "*crêpe*" ring. Shading off gradually as this ring does from the inner edge of the bright one, it is natural to suppose that it is a portion of the former ring in which the fragments or "meteorites" are more sparsely distributed, their numbers growing gradually less as the distance from the main ring increases, until the eye can no longer detect their mass and the ring apparently ends.

This explains why the outline of the planet can be seen through the dark ring; but if this fact is not enough, an observation made on November 1, 1889, at the Lick Observatory will further confirm the theory. This observation was of the outer satellite, which was in such a position behind the planet as to pass through the shadow of the rings and be eclipsed by it. Watching the satellite, then, as it left the planet's shadow and slowly passed on into the shadow of the rings, its light was seen to grow gradually fainter as it passed through the shadow of the dark ring, but did not wholly disappear until the moon had entered the shadow of the inner bright ring. This shows clearly that the dark ring is partially transparent, but becomes more opaque as the bright ring is approached.

With regard to the satellites there is little to be said. There are eight known at present, and there may be more, for they are mostly quite small, as heavenly bodies go. Still, they form the most numerous as well as the most extended family within the sun's domain, for the outer one of all swings around Saturn at a distance of two and a quarter millions of miles—ten times as far away as our own moon. This one, which is named Japetus, is just about the size of the moon, and apparently shares the latter's peculiar trait of always keeping one side toward its ruling planet. This supposition is due to the fact that when on the western side of Saturn Japetus is always very much brighter than when to the eastward; in fact, though easily seen with a telescope of moderate power when brightest, it will almost entirely disappear when faintest. It is difficult to explain the cause of such a marked change, for one half of the satellite must be extremely bright and the other half very much darker to produce it, but the fact remains.

Titan, as its name implies, is the largest of the group, and in size is midway between Mars and Mercury—in fact, it would make a very respectable planet itself, for it is nearly half the diameter of the earth. The other six are all considerably smaller than our moon, and have been discovered in the order of their brightness, their discovery keeping pace with the increase in the power of telescopes, so it is quite possible that there may be others in this already numerous family to be introduced later on.

We spoke in the beginning of this article of destroying the theories often put forth concerning the inhabitants and conditions of life upon this far-off world. There are certain facts and deductions, however, from which we can gain an idea of some of the conditions which may prevail when Saturn has finally reached a stage where life will be possible upon its surface, and it may not be uninteresting to consider some of their peculiarities.

In considering the climatic conditions of a planet we find they depend principally upon three factors: the distance of the planet from the sun, the inclination of its axis, and the length of its year, with incidentally the length of its day. What the results of this combination may lead us to expect in the case of Saturn we will point out by using the earth, naturally, for analogy or contrast.

In the first place, as affecting animal and vegetable life, the greater distance of the sun, and the corresponding decrease in its lighting and heating power compared with the same effects on the earth, would materially change in itself the character of such life on Saturn. As already noted, the heat and light are reduced to nearly one one-hundredth of their intensity here, but no one can tell what compensating features may ultimately be provided for retaining the internal heat of the globe or storing up the sun's heat. As an instance of such adaptation we have only to turn to the planet Mars, where we have visual proof, in the melting of its polar "snows," of a much milder climate than the earth possesses, although the intensity of the sun's heat there is reduced by half.

In connection with the foregoing is the question of the composition of the atmosphere, and whether it could support such organisms as we are familiar with in terrestrial life. The spectroscope has told us but little about Saturn's atmosphere, but it is known that the planet is provided with one of considerable extent, and apparently of a similar constitution to our own. The presence of water vapor has been detected, according to some observers, but not positively; yet it is fair to suppose from other considerations that this most necessary adjunct of all life is plentifully supplied.

The change in the seasons will, of course, depend upon the inclination of the axis, which in Saturn's case is twenty-six and a half degrees from the perpendicular to its orbit. When we remember that the corresponding inclination of the earth's axis is twenty-three and a half degrees, it will be apparent that the change of seasons would be quite similar to ours, the sun merely rising three degrees higher in the heavens at the summer solstice and three degrees lower at the winter solstice. But the length of the seasons, determined by Saturn's long journey around the sun, will be, on the average, nearly seven and a half years, a fact which would render unlikely much similarity in organic life to the forms found on the earth. If we add to this the rapid succession of day and night, each being at the equator of but five and a quarter hours' duration, we may look for still further dissimilarity; but the greatest difficulty comes when we consider the effect of the rings.

At first thought it might seem that the rings would have little to do with the climate of the planet, and in fact such is the case during the summer of either hemisphere; but winter tells a different tale, as we shall see. Since the rings lie exactly in the plane of the planet's equator, they will be presented edgewise to the sun at the equinoxes, when the sun is "vertical over the equator." At this time their shadow, part of which must fall on the planet, will lie directly on the equator, and presumably be about as wide as the general thickness of the ring system, which is estimated to be not more than one hundred miles.

As the sun travels northward from the equinox, it is apparent that the shadow will fall farther and farther south of the equator until it has covered the whole southern hemisphere, save a portion of the torrid zone where the light comes through the space between the rings and the planet. After the summer solstice the effects are reversed: the shadow retreats toward the equator, and after the succeeding equinox the southern hemisphere will have its summer undisturbed, and the northern hemisphere in turn will have its long winter made still more dreary by this remarkable daily eclipse of the sun. It thus appears that only in a relatively narrow belt lying on either side of the equator would be likely to occur climatic conditions approaching those with which we are familiar.

One often sees in articles on astronomy some reference to the grandeur of the Saturnian heavens at night, where, in addition to the starry host familiar to us all, would be the wonderful ring spanning the sky as an arch of golden light, and eight moons in their various phases. In a measure this is true, but it depends upon circumstances. During the summer half of the year in either hemisphere the illuminated side of the rings is, of course, visible—perhaps even faintly so in the daytime, as is the case with our moon; but when the twilight falls and the golden arch shines forth in all its beauty against the darkness of the sky, it must certainly be a sight which for grandeur surpasses any celestial phenomenon known to us, save possibly a total eclipse of the sun.

As soon as the sun has set, however, the shadow of the planet, where it falls upon the rings, rises in the east and mars the beauty of the arch as it travels across it during the short night and disappears in the west at sunrise. At the summer solstice, though, the sun rises high enough in the heavens, or, more correctly, the planet's axis is inclined far enough toward the sun to bring the outer ring clear of the shadow, which then appears somewhat conical in shape and reaches across the inner bright ring nearly to the outer one.

But after the autumnal equinox and during the winter season all this is changed. Not only do the rings cause daily eclipses of the sun, but they give no illumination at night, for their dark side is then toward the observer, and they can be only "negatively visible," so to speak—that is, their position in the sky is shown merely by the absence of stars in that portion.

As to their appearance from various positions on the planet, it might be said that the whole system is visible above the horizon as far as latitude 41°—that of New York and Constantinople in our northern hemisphere, and Tasmania and New Zealand in the southern. At this latitude the inner edge of the dark ring will be upon the south point of the horizon, and the arch will extend about a third of the way toward the zenith. When latitude 51° is reached, that of Dresden and Winnipeg, Manitoba, the dark ring will have sunk below the horizon, but the whole width of the bright rings will be above it; and, finally, at latitude 66° 30′, that of our Arctic and Antarctic Circles, the entire system will have disappeared.

Of the illumination given by the moons in the absence of the rings we must say a little, since one often sees some statement to the effect that so many moons must compensate in some measure for the diminution of sunlight. But as the moons are illuminated by this very sunlight, their brilliancy is reduced in the same ratio, and in Saturn's case their total light in no wise makes up for this loss.

Reckoning from the best estimates of their sizes, we find that the total area on the sky covered by the moons when full is about two and a half times the area of our own moon, but their illumination, could they all be full at once, would be only the fortieth part of what we are accustomed to at the full. Then, again, as all of them except Japetus, the outer one, lie in the plane of the equator, it is evident that at the equinoxes, when this plane passes through the sun, they will all suffer total eclipse at the full, and will continue thus until the increasing inclination of the axis toward the sun brings their orbits one by one outside the shadow at this point. Thus we see that this numerous retinue does not amount to so much, after all, in the matter of illumination.

One other feature, and one which would doubtless be noticed first of all were any of us suddenly transferred to another planet, would be our change in weight due to the change in surface gravity. If we take the dimensions of Saturn as revealed by the telescope to represent its true size, we should find much less difference than one would expect, considering the tremendous size of the planet. The combination of three factors—the much greater distance of the surface from the center of the planet, which is the center of the attraction we call gravity; the much greater "lightness" of the materials composing the planet; and the great centrifugal or "throwing-off" force at the equator, due to the rapid rotation, and which would, of course, counteract to some extent the downward pull of gravity—results in making but a slight increase, so that a man weighing one hundred and fifty pounds on the earth would weigh only about six pounds more at Saturn's equator. At the poles, however, the change is more marked, since there is no centrifugal force, and the polar flattening, due to the rapid rotation and consequent bulging at the equator, brings one nearer the center of the planet. In this case the increase would be about thirty-six pounds, and would probably be found somewhat uncomfortable to us.

However, it is by no means certain that the dimensions seen through the telescope are the right ones to consider in this manner. If all we have ever seen of the planet is the outer side of its cloud envelope, it may be that the true surface, provided there is one at all, is far beneath the tops of these rolling cloud masses; and if there is no real surface yet—if the terrible struggle of fire and water for the mastery is still in full sway—no one can tell just what the size of the globe may be when the crust finally forms and the real planetary life begins. This "distended mass of liquid fire" may have shrunk perceptibly by that time.

This also brings up one other interesting query. The spectroscope has proved that the sun and stars are composed of materials with which we are familiar in our laboratories, and Saturn as well as the other planets must be composed of the same chemical elements, though probably with wide variations in combination and distribution. If, then, Saturn were to approach the earth in the density of its composition when it reaches a corresponding stage in its planetary growth, it must shrink to *one eighth* its present volume, or one half its present diameter. On the other hand, if its size remains anywhere near the present dimensions, we shall almost be forced to the conclusion that this great globe may eventually become one vast ocean—a dreary expanse of water with perhaps only a relatively small solid center, thousands of miles below the surface.

But whatever its future, it will always remain a most interesting object of study, and no one can consider it thoroughly without being inclined to agree with Richard Proctor, that here certainly must be a world "altogether more important in the scheme of creation than the globe on which we live."

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NORTH AND SOUTH.

By SPENCER TROTTER.
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A WRITER has somewhere remarked upon the different atmosphere that surrounds two well-known railway stations in the city of Baltimore. The Union Station, in the upper and newer section of the city, has about it all the life and bustle of a Northern railroad center, while at the Camden Station, for so many years the terminus of a Southern trunk line, there is an air of easy-going uncertainty that breathes of the South. If this difference in the influence of the Northern and the Southern life is felt within the narrow limits of a metropolis, it is still more apparent in the region that lies between the "City of Monuments" and its more northern neighbor. As a matter of fact, the frontier of the South extends some distance north of the region with which we are accustomed to associate it, and the real line of demarcation is a natural boundary fixed by certain well-marked geographical features and indicated by the distribution of certain animals and plants. When Mason and Dixon ran their celebrated "line," they did more than settle the dispute of a boundary between colonial Commonwealths. Their arbitrary survey embodied, in an approximate way, a more or less natural division between the people of two great physical areas, each one of which is broadly defined as a distinct geographical and political unit—the North and the South. Each of these domains is characterized by certain marked peculiarities, both in natural productions and in the life of the people, which have their origin in climatic and topographical features. Through nearly two and a half centuries the physical environment has slowly worked its subtle influence into the blood and tissues of the inhabitants in each contrasted area, producing a certain cast of thought, speech, and action which are highly characteristic and which present unmistakable marks of difference.

The Northern and the Southern seaboard States of the Atlantic slope are decidedly different in their physical aspects as a result of topography. The numerous mountain ranges embraced in the Appalachian highland have a long, southwesterly trend from New England to Alabama. In the former section, north and east of the lower Hudson Valley, the eastern slopes of the mountainous highland reach to the sea, forming the bold and rocky coast line of New England. South of the Hudson the mountain ranges become more nearly parallel; and the long chains of the Blue Ridge and the Alleghanies, trending more and more toward the southwest, stand some distance inland, leaving a gently sloping lowland between them and the ocean—*the Atlantic coast plain.*

The coast plain is first found as a narrow strip in New Jersey. A line drawn from about the locality of Long Branch diagonally across the State to the Delaware River, at a point some distance below Philadelphia, serves roughly to indicate its inland boundary, marking it off from the upland terraces that form the foot of the highland slope. The line of demarcation then runs more and more inland, cutting off a small section of southeastern Pennsylvania, and, proceeding across the upper streams and estuaries of Chesapeake Bay, passes along the edge of the mountainous regions of Maryland and Virginia and the upland slopes of the Piedmont lands in North Carolina.

The traveler who journeys southward through William Penn's "low counties" finds himself on this line of demarcation between "the North" and "the South." Philadelphia, the last of the "Northern cities," lies behind him, and when Baltimore is reached the traveler begins to feel that he has passed into a different atmosphere. A certain unmistakable difference in voice and speech and a softer manner are, more than anything else, the first Southern characteristics to strike the stranger. The colored folk become more plentiful, and pickaninnies at the doors of whitewashed cabins form a not unfamiliar foreground touch in the landscape south of the city of Penn. From a car window one sees little of the change that comes over the face of Nature in passing from one region to another. But to him who fares by the way, with a keen instinct for things afield, comes the knowledge of just where the subtle change takes place. For it is by the range of country that a bird inhabits or where some particular tree or wild flower grows that Nature maps out the boundary lines of regions.

Naturalists have long recognized the fact that certain kinds of animals and plants were characteristic of certain regions of country, and that the boundaries of these regions coincided with lines of temperature or isotherms. Every species of animal and plant is definitely related to a certain fixed quantity of heat which is required for the full development of its reproductive activities. It is a habit fixed by purely physiological conditions. Various species of animals and plants, for some occult causes dating back to a remote period in their history, require a greater amount of heat throughout the period of reproductive activity than do other species, even though they be closely related. The species of animal or plant that requires the greater sum total of heat will find the northward limits of its range farther south than the species that requires a less amount. The breeding range of many birds, the dispersal of various species of mammals and reptiles, and the growth and development of many different kinds of forest trees and wild flowers are thus definitely outlined.

Topographical conditions exert an important influence in the distribution of surface temperature. High mountain ranges, running southward, carry the cooler or more temperate conditions of the regions to the north along their crests far into the warm zone which they penetrate. Likewise, lowland plains, extending northward, carry the conditions of greater warmth into the cooler area of higher latitudes. It is not surprising, therefore, in passing from lowland to upland districts to find more or less of a change in the character of the vegetation and in the animal life. Certain species, quite abundant in the lowland region, disappear on the higher ground, where other kinds, not met with in the lowlands, make their appearance.

Through the researches of biologists * it has been found that the continent of North America may be divided north and south into several great temperature belts or heat zones, each one of which is characterized by peculiarities in its inhabitants. The boundaries of these heat zones are marked by isotherms which include a certain definite range of temperature that characterizes the contained area of country and which is definitely related to the reproductive functions of the animals and plants inhabiting it. It is an interesting fact to note that the isotherm representing the boundary between two of these heat zones coincides with the line that marks off the inland border of the Atlantic coast plain from the interior uplands of the highland region. If we turn our attention to the distribution of life in North America, we shall find some facts that do not quite agree with our already conceived ideas as to the divisions of the continent. An irregular line drawn from the coast of northern New England northwestward across the Great Lakes to the head waters of the Saskatchewan serves roughly to mark off a vast northern area known as the *boreal zone.* Its chief characteristic is the predominance of coniferous forests which stretch away northward to the Barren Grounds of arctic America. The inland border of the Atlantic coast plain, after bending around the end of the Appalachian highland region in northeastern Alabama, runs northward along the western base of the mountains to Lake Ontario. Then, turning sharply westward, it pursues an irregular course across the lower lake region and upper Mississippi Valley to the base of the Rocky Mountains. This extremely irregular line marks off a vast territory to the south known as the *austral zone*. It is evident that the southern boundary of the boreal and the northern boundary of the austral zones do not coincide, but leave more or less of an intermediate territory where the peculiar types of the northern and the southern life mingle. This overlapping area is known as the *transition zone*.

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* Especially those of Dr. C. Hart Merriam. See National Geographic Magazine, vol. vi, p. 229. The Geographic Distribution of Life in North America. From Smithsonian Report for 1891, p. 365.

Dr. Merriam has shown that these three great life zones—boreal, transition, and austral—are also temperature zones, each one of which is characterized by a definite sum total of heat throughout the reproductive period. Thus the mean daily summer temperature of the boreal zone never aggregates above ten thousand degrees Fahrenheit, while the daily temperatures of the transition zone always aggregate above this. The austral zone is marked by two temperature belts—the upper austral, aggregating above eleven thousand five hundred, and the lower austral, aggregating above eighteen thousand degrees Fahrenheit. It is a significant fact that this subdivision of the austral zone into two temperature belts conforms exactly with its subdivision into two characteristic life regions. The boundary separating these is indicated by a line that, starting at the mouth of Chesapeake Bay, runs southwestward to the borders of Georgia and Alabama, and, then turning northward, reaches the mouth of the Ohio. This line of demarcation coincides with what geologists know as the "fall line," where the various rivers, in their course from the highland region to the sea, break into a series of rapids as they flow from the higher and older formations of the Piedmont lands to the lower and more recent Tertiary deposits of the alluvial plains.

Each of these great zones is characterized by the presence of certain animals and plants that do not range beyond its limits. A traveler journeying northward from the tropical shores of the Gulf States, with their flocks of pelicans and flamingoes and their characteristic palms and mangrove swamps, marks the change from one region to another in the different species of plants and animals which he encounters. The change in vegetation alone is striking. The persimmons, tulip trees, magnolias, sweet gums, sassafras, papaws, and other forms that characterize the landscape of the Southern States give place to the oaks, hickories, and chestnuts, and, farther north, to the maple and beechwoods and the birches and aspens of the highland and mountain regions in the Middle States and New England. Beyond these deciduous woods of the transition zone the traveler enters the vast domain of coniferous forests that mark the boreal region of North America. Days of journeying through the wilderness of evergreens bring the wayfarer at length out into the "tree-line zone," scattered clumps of spruces and firs that straggle along the southern edge of the inhospitable Barren Grounds of arctic America—a treeless, blizzard-swept waste of mosses and saxifrages, the home of the wolf, the musk ox, and the Barren Ground caribou, stretching away to the shores of the Arctic Ocean.

Zoölogists recognize several well-defined regions within these life zones, each of which is characterized by some forms of reptiles, birds, and mammals that do not range or breed beyond its limits. These geographical life areas have received the name of *faunas*. In the eastern United States four such regions are recognized and are known as the *Canadian*, *Alleghanian*, *Carolinian*, and *Louisianian* faunas. The Canadian fauna belongs to the boreal region. It is characterized by certain species of mammals that do not range south of it, as the moose, caribou, and wolverine, and by certain birds that breed within its borders. Among these latter are the well-known snowbird, several species of wood warblers, the winter wren, and the hermit thrush. This fauna extends southward to Georgia along the hemlock-crowned crests of the Appalachians, where the altitude produces conditions similar to those prevailing in the coniferous forests of the boreal zone to the north. Through the deep, cool shades of these hemlock woods floats the song of the hermit thrush—a vesper strain that falls on the sense like the tinkling of some far-off, sweet-toned bell, rising and swelling in an amplitude of liquid melody that fills the twilit aisles and dies away in still solitudes. The pleasing song of the snowbird breaks upon the forest stillness, quite different from its sharp, clicking notes so familiar in our winter walks about home. Along the brawling mountain brooks and trout streams of the Alleghanies the water thrush, with oddly jerking motions, bobs up and down on the rocks, and the winter wren flits about the windfalls or steals away from its nest, that is hidden under the gnarled roots of some old stump that overhangs the bank. To an ornithologist these and other features indicate a decided Canadian tinge in the summer bird fauna of the higher ranges from the Catskills to Georgia.

The so-called Alleghanian fauna of the eastern transition zone includes all the more familiar species of birds, reptiles, and mammals inhabiting the New England and Middle States and the lower ranges of the Appalachian highland to the south. Its chief characteristic is a mingling of the life of the other two zones—the boreal and the austral. Such decidedly northern forms as the bay lynx or catamount, the red squirrel, porcupine, woodchuck, chipmunk, jumping mouse, and certain other mammals find their ranges restricted along the southern boundary of this fauna. A number of familiar birds, as the brown thrasher, scarlet tanager, bluebird, house wren, chewink, indigo bird, meadow lark, the orioles, the common dove, and the bob-white or quail do not breed beyond its northern boundary. The brook trout does not range south of this fauna, and the rattlesnake, the copperhead, the puff adder, the green snake, the milk snake, and the water snake are not found beyond its northern border.

The Carolinian fauna is a distinctly southern type and characterizes the upper austral zone, which includes that portion of the coastal plain region that reaches from the foot of the Appalachian highland to the "fall line" of the various Atlantic streams. The northern limit of this fauna thus coincides with the inland border of the coastal plain which we have already referred to and which may be looked upon as the *true dividing line between the North and South.* The presence of such birds as the cardinal, the yellow-breasted chat, the Carolina wren, the tufted titmouse, the Acadian flycatcher, and the blue-winged, Kentucky, and worm-eating warblers during the breeding season is a sure sign of the Carolinian fauna. These species never go beyond its northern limits. Moreover, such species as the brown thrasher, the wood thrush, the house wren, the chewink, the dove, and the field sparrow, which find their northern limit in the transition zone, are far more abundant in the Carolinian region, and might almost be regarded as representatives of its fauna.

It becomes a matter of profound interest, not only to the ornithologist and the student of geographical distribution, but to every one who has in his heart a love of woods and fields, to locate this natural boundary by such fine shadings as the nesting place of a bird or the habitat of a forest tree. Let us take that portion of the line that cuts off a small corner of southeastern Pennsylvania. To the ordinary observer this special tract of country presents no marked difference from the landscape a hundred miles or more to the north or south of it. Its detail of features is quite similar and seasonal changes follow much the same course that they do in northern Virginia and southern New England. To the northwest, beyond the low, irregular ridge of the "upland terrace" that marks the gneiss and schist rocks of an ancient shore line, the country breaks into the rolling hills and dales of the interior uplands. To the southeast lies the flat lowland of the Delaware plain, and beyond this the pine barrens and marshes of the Atlantic coast plain of New Jersey. One who has an eye for the woods, however, will note a certain change in the trees from southern New England and the highlands of the Middle States. Groves of tall tulip trees, with their broad, smooth leaves of shining green and large, creamy blossoms streaked with orange that open toward the end of May, form a characteristic feature of the woodland scenery. The sassafras and the persimmon are scattered more or less abundantly through the woods and old pastures and along the borders of the streams. The sweet gum or bilsted, with its gray-colored branches winged with corky ridges, its spiny autumn fruit, and its five-starred leaves, fragrant when crushed and turning crimson in the fall, is a characteristic tree of this borderland. Curiously enough, too, it is confined to the lowlands, growing quite abundantly in the moist woods along the Delaware just south of Philadelphia, but unknown in the northern suburbs save as a transplanted tree.

These woodland features give a decided southern tinge to the region, and are especially significant when we come to know that the tulip tree belongs with the magnolias, a typical southern group, and that the persimmon is one of the ebony trees, a family characteristic of the tropics. But it is the presence of a Carolinian element in the fauna, especially the bird fauna, that marks this region as the beginning of the southern realm. At all seasons of the year the clear whistle of the Virginia redbird—the crested cardinal with mask of black—may be heard in the woods of the lower Delaware Valley and along the tributary streams. I have seen its flash of red against the whiteness of midwinter snowdrifts. In the bramble thickets that fringe the streams and on the wooded slopes above, the Carolina wren finds a home the year round, and its clear, ringing song breaks loudly on the frosty stillness of late winter mornings. I know of no more characteristic sounds in these woods in the early springtime than this wren's song and that of the tufted titmouse. It is a noteworthy fact that these three Carolinian birds are resident throughout the year along the northern limit of the fauna. When the spicebush has blossomed, and "all the wood stands in a mist of green," the first bird waves of the spring tide of migration appear. We wake some morning to hear the chipping sparrow striking pebbles together, and catch the plaintive song of the field sparrow in the pastures and the budding copses along the edge of spring woods. Only yesterday these sounds of the spring were but a memory. The thrasher pours out a medley of sweet notes from the high tree top, and later, in the warm days of early May, the reedy, mellow lute of the wood thrush comes from the bosky glade. During the migration the voices of birds sound unceasingly through the woods from dawn to twilight. When the blackberry is white with blossoms and the arrowwood is in bloom, most of the migrants have passed on to their northern breeding grounds, and those that stay with us have built their nests. Among these latter are several Carolinian birds. In the depths of smilax and brier-tangled thickets the skulking chat—the wildest bird of the woodland—utters its weird, delusive cries. The low-pitched, insectlike notes of the blue-winged warbler and the song of the worm-eating warbler that sounds like a chipping sparrow in the underwoods, where a chipping sparrow is never found, remind the ornithologist that he is on the edge of the Carolinian zone, for these and the handsome Kentucky warbler find their breeding limit on the northern confines of this fauna.

One of the most characteristic birds of this region, and yet one of the most unfamiliar, is the curious barn owl, which makes its home in certain low tracts of woodland south of Philadelphia. Those of us who were brought up on the transatlantic story books of a generation ago know this bird as the strange-faced "staring owl" of our childish fancies. The barn owl of this country is only a geographical race of this long familiar owl of the English towers and belfries.

The turkey buzzard, though frequently observed as far north as southern New England, is never found abundantly beyond the Carolinian fauna. It nests among the rocks, often in communities of considerable size, in southern Pennsylvania, and winters in southern New Jersey. Almost any day from April to November numbers of turkey buzzards may be seen in the neighborhood of Philadelphia, soaring on motionless wing, often at a great height, or gathering in large flocks over the woods to feast on the carcass of some animal. Farther south, especially toward the coast, the turkey buzzard becomes less abundant where the black vulture or carrion crow, a closely related species that scarcely ever occurs north of Charleston, takes its place.

A notable mammal of the southern realm is at home in the woodland tracts of this region. The opossum is quite as abundant along the northern edge of the Carolinian fauna in southeastern Pennsylvania and New Jersey as it is farther south, but is rarely found north of this locality on the Atlantic seaboard. Its nocturnal habits preclude it from ordinary observation, and only in the autumn and early winter, when tempted into some rabbit snare or caught in its predatory midnight rambles and its fat body swings before the market door, are we aware that this curious marsupial dwells in our midst. From the Delaware southward a fat "'possum" is the delight of the darkey, and most toothsome is it indeed if caught in a persimmon tree after feeding on the frost-ripened fruit. A less common mammal is the little gray fox, which formerly was much more abundant on the northern range of the Carolinian fauna than it is at the present day. The gray fox must be the "Brer Fox" of Uncle Remus, for the more familiar and larger red fox of the Northern States does not range far beyond the limits of the transition zone. The red fox is now the most abundant species in southeastern Pennsylvania, and this may be due to a difference in habits. The gray fox makes his lair under the roots of a tree or a shelving rock, while the red fox tunnels out a burrowlike den underground. With the clearing of the country this last is undoubtedly the most favorable method of holding territorial rights.

The southern portion of New Jersey presents a unique area in the Middle Atlantic States. In all its essential features—topographical, geological, and also in certain biological aspects—it is related to the region farther south, being the northward extension of the Atlantic coast plain. The most characteristic feature is the "pine-barren" region that reaches from the foot of the higher country to the maritime marshes and beaches that immediately fringe the coast. The tourist journeying to the seaside resorts south of Long Branch has the monotonous sandy waste of the pine barrens for a landscape. Here and there the white, loamy soil gives place to loose beds of yellow gravel. Sluggish streams of water, stained dark brown from the leachings of the cedar stumps, meander through swampy jungles. The landscape varies somewhat with the character of the trees in different places. In some sections the tall pitch pine forms vast stretches of forest, while in others a low and scanty woodland growth of the "Jersey" or scrub pine and several species of scrub oak prevails. The cedar swamps that lie scattered in the course of the numerous streams form a remarkable feature of this interesting region. Dense jungles of white cedar growing out of the dark water and surrounded by an impenetrable undergrowth of tangled vines and brier thickets form a harbor for many wild animals and birds. The tropical effect of these cedar swamps is heightened by broad-leaved magnolias and the long festoons of graybeard moss that fringe the branches. In these dark recesses, and through the pine barrens generally, the botanist finds many plants which belong to a more southern flora. Indeed, all the way along the coast from New Jersey to Maine, in favorable situations, representatives of distinctively southern forms may be found which in these higher latitudes do not occur inland. The mockingbird, which is highly characteristic of the Louisianian fauna, has been met with as a straggler during the breeding season in the New Jersey pine barrens; and in the cedar swamps near Cape May the hooded warbler, a typical Carolinian species, breeds regularly. In times long past the rare and curious Carolina parroquet, now known only from the Gulf region, was an occasional visitor as far north as the lower Delaware and its tributaries.

River valleys are topographical features of great importance in determining the distribution of living beings. The conditions of greater humidity and higher average temperature that prevail in the bottom lands along a river's course, as compared with the higher ground of the upland districts which forms its watershed, is strikingly illustrated in the case of Carolinian birds. Certain species are found regularly during the breeding season in the valleys of the Susquehanna, Delaware, Hudson, and even the Connecticut Rivers, extending inland for a greater or less distance, but are unknown in the surrounding higher country. Thus, Carolina wrens, cardinals, turkey buzzards, and other no less characteristic Carolinian birds are abundant in the bottom lands along the Susquehanna in Lancaster County, Pennsylvania, but are scarcely ever found on the uplands above the wooded slopes of the river, though the conditions of food and shelter seem equally favorable.*

Much of the outside world enters a man's soul and becomes the ground of his joy through life. We all owe something to the region in which we dwell, unconsciously perhaps, but still something that is assimilated by the tissues of the inner life, and that goes to the making of what we really are. Those of us who dwell on the borderland of Dixie owe some fragmentary moments of inspiration, even of happiness, to the genial influence of its proximity. We think of ourselves as belonging with the North, but has not the South spun a few threads into the web of our lives? The cardinal whistles the same sweet tune as he does in "Old Virginia"; the opossum and the persimmon savor of the South; even the turkey buzzard suggests the warmer clime. And then spring is always two weeks earlier just down the Delaware, and this is something; even if it is too far off to start the "spring feeling," it hints of fresh early strawberries and the first run of the shad.

PROF. J. J. THOMSON, addressing the Section of Mathematics and Physical Science in the British Association, was able to testify to a great improvement which had taken place in the teaching of science in the public and secondary schools during the past ten years. The standard in physics attained by the pupils was increasing from year to year. There might, however, be danger of a temptation to make the pupils cover too much ground. "Although you may increase the rate at which information is acquired, you can not increase in anything like the same proportion the rate at which the subject is assimilated, so as to become a means of strengthening the mind and a permanent mental endowment when the facts have been long forgotten." In the university training of intending physicists the preservation of youthful enthusiasm was, in the speaker's opinion, one of the most important points for consideration; and this could best be effected "by allowing the student, even before he is supposed to be acquainted with the whole of physics, to begin some original research of a simple kind under the guidance of a teacher who will encourage him and assist in the removal of difficulties. If the student once tastes the delights of the successful completion of the investigation he is not likely to go back."

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* Witmer Stone. The Birds of Eastern Pennsylvania and New Jersey, p. 10.

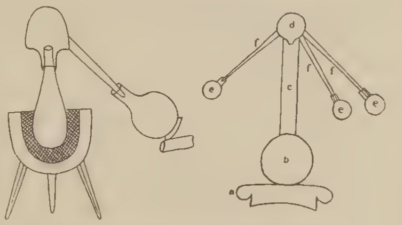
THE HISTORY OF ALCOHOL.

By Prof. CHARLES ERNEST PELLEW.

II.

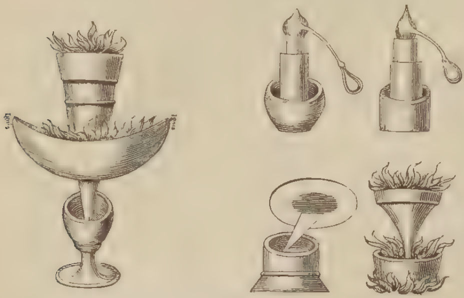
IT is a curious fact that, although intoxicating beverages have been known and used from time immemorial, alcohol itself was not discovered until after the fall of the Roman Empire, and, when once discovered, it was not used for intoxicating purposes for many hundred years. Pliny, in his Natural History, written about A. D. 50, mentions that oil of turpentine could be extracted from the crude pitch by boiling the latter in open vessels and catching the vapors on fleeces, from which the condensed oil could be pressed. This marks the first beginnings of the art of distillation, which progressed but slowly, for, two hundred years later, we read that sailors were accustomed to get potable water from sea water by similar crude methods.

About this time there existed a flourishing school of alchemists at Alexandria, and it is probable that some of them had, or soon would have, developed the art further. But A. D. 287 the Emperor Diocletian destroyed their books and prohibited their studies, for fear lest by discovering the philosopher's stone, and hence learning to change base metals into gold, they might overturn the Roman rule. A more serious disaster befell the later Alexandrian School of Philosophy in the destruction of the famous Alexandrian Library by the Mohammedan general Amru, A. D. 984, at the orders of the Caliph Abu Bekr. "If the books agree with the Koran, they are not needed; if opposed, they are injurious." This was the argument which helped to put back civilization some centuries, and gave Literature, as well as science and medicine, a blow from which she has not yet recovered. It is curious to speculate what would be our present condition if only two or three of our recent advances—the discovery of galvanic electricity, for instance, or the germ theory of disease—had been made but one hundred years earlier.



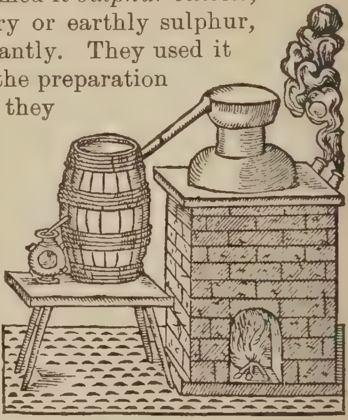
OLD STILLS USED BY ALEXANDRIANS.

As it was, the study of science had to be begun over again almost from the very foundation by the Arabians under a more enlightened rule. The famous Geber about the close of the eighth century mentions the term distillation, but it is doubtful whether he understood much more by it than the separation by heat of two metals of different melting points. Albucasis, a famous alchemist of the eleventh century, speaks of the process in less doubtful terms, and late in the thirteenth century the art of distillation and the preparation, properties, and uses of alcohol were clearly described by two European alchemists, Raymond Lully and Armand de Villeneuve.



Old Stills, from Early Edition of Geber.

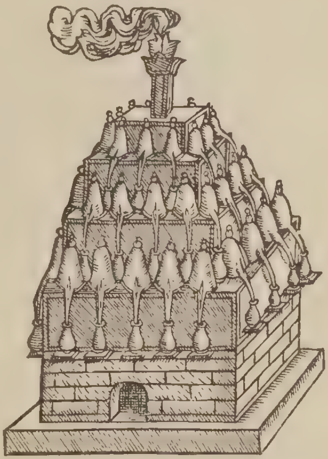
In view of the fierce and indeed not undeserved abuse that has been levied against distilled liquors, it is interesting to note that for some hundreds of years after its discovery alcohol was distinctly the most valuable product of chemistry. The old alchemists went wild over it. They wondered at its power of dissolving oils and resins and balsams, calling it *oleum vini* and *balsamus universalis*, and making with it varnishes and perfumes and cosmetics, by the sale of which they replenished their not overfilled purses. They admired the clear, colorless, smokeless flame with which it burned, and named it *sulphur cœleste*, in contradistinction to the ordinary or earthly sulphur, which burns by no means so pleasantly. They used it as a preservative, they used it for the preparation of their chemicals, and above all they used it as a medicine.



Still for Aqua Vitæ, Countrie Farme.

For during many hundred years this *aqua vitæ*, water of life as it was almost universally called, was the most valuable medicine in their large but inefficient pharmacopœia. Each alchemist, each physician, prepared his own elixirs, his own cordials, and claimed miraculous results for his own particular nostrums: but the basis of them all was the same—namely, alcohol, sweetened with sugar, and flavored by distillation or infusion with herbs and spices. Some of these "cordials" or heart remedies exist at the present day in the form of the various liqueurs. The Chartreuse and Benedictine are simply the same old medicines, prepared after practically the same old formulæ, that the Carthusian and Benedictine monks used to distill hundreds of years ago to give to the sick and feeble at their convent doors, or sell to the wealthy invalid who sought their treatment.

But the curious part of it is not that it should have been used as a medicine, but that it should have been used as a medicine exclusively. There seems to have been little or no idea of its intoxicating power. In Shakespeare, for instance, there is abundant mention of drinking and drunkenness. But Cassio, and fat Sir John, and the rest got tipsy on sack, and canary, and sherry, or, if of lower rank, on ale and beer, but never on spirits. Indeed, the only mention of distilled liquors in all his plays is in Romeo and Juliet, where the old nurse sighs, "Oh, for some strong waters from Venice!" to restore her energies. As an example of how long this state of affairs continued I may mention a well-known book, The Countrie Farme, published in England in 1616. This large and important work discusses in great detail all the varied occupations of a large country place. It describes carefully the wine industry, the culture of the vines and grapes, the preparation and the varieties of wine, and, while highly praising good pure wine as a beverage, the author is extremely careful to describe fully and with much emphasis the many evil effects which come from intoxication, and from constant as well as from overmuch winebibbing.

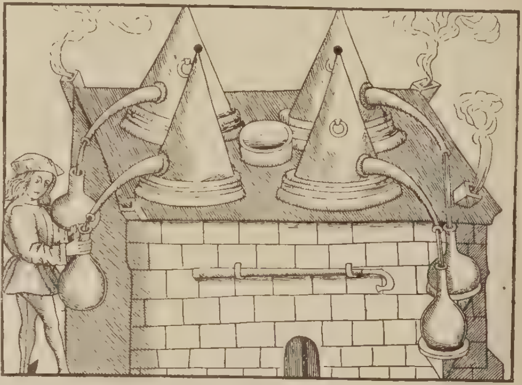

Household Still, Countrie Farme.

A few chapters further on the author describes the art of distillation. He explains that a still room was a necessary adjunct to a well-equipped country house, and shows curious illustrations of stills, some of them with sixty or eighty retorts on one oven. He mentions the great variety of vegetable and animal substances from which extracts could be and should be distilled, but spends most of his time upon the distillate from wine. "For," says he, "the virtues of *aqua vitæ* are infinite. It keepeth off fits of apoplexie—it driveth away venime. . . . In wet and malarial climates every one should take a teaspoonful, with sugar, before breakfast, to keepe off the ague," and so on. Not one word about intoxication—purely as a medicine.

It is not to be supposed from this, however, that the English

Tartars distilling Koumyss.

did not have plenty of ways of getting tipsy. They had long been known as ranking next to the Germans and the Dutch for their drinking powers. The Saxons and the Danes had both introduced into England the intemperate habits of the Northmen, and beer and cider, and mead or metheglin made from honey, were quite as efficacious in their way as stronger beverages. The Normans were a more refined and far more temperate race, and it is for this reason, in large part, that they conquered England so readily. The night before the battle of Hastings, so the old chroniclers tell us, was spent by the Saxons in drinking heavily and uproariously around their camp fires. "Next morning, still drunk, they recklessly advance against the enemy," so we read in the old monkish Latin, while the Normans, passing a quiet, peaceful night, were cool and well prepared for the decisive struggle.



Ancient Still for Extraction of Essential Oils and Perfumes.

Their habits, however, soon deteriorated, and they drank almost as heavily as their predecessors. In the reign of Henry I the nation suffered a grievous loss, from overindulgence in liquor, in the sad drowning of his eldest son, just married to a princess of France. The wedding party were returning to England on a galley, amid the rejoicing of both nations, and wine flowed freely on board, until even the seamen became intoxicated. As they were nearing the shore, the galley ran upon a sunken rock, and out of the whole company but one person escaped. The young prince, it was said, with his bride and some attendants had pushed off from the ship in a boat, but he insisted on returning to try to save his sister, when the boat was upset, and all perished together.

All during the middle ages, in the chronicles of Froissart, Holinshed, and others, we find records of the fact that our English ancestors, then as now, "liked a glass of good beer," and of wine too. Sir John Fortescue naively says, "They drink no water, except when they abstain from drinks, by way of penance and from principles of devotion." In 1498 the Spanish ambassador at the English court wrote to Ferdinand and Isabella to ask that Princess Catharine of Aragon, betrothed to Prince Henry, afterward Henry VIII, should learn to drink wine. This was a

George IV as Prince Regent. (Gillray.)

good-natured tip from the English king and queen, who wished their future daughter-in-law to know that "water in England is not drinkable, and, even if it were, the climate would not allow the drinking of it." Heavy drinking was not by any means confined to the laity, for there are constant complaints of the habits of the clergy, and especially of the religious orders. The drunkenness of both monks and nuns was one of the main excuses for closing the monasteries by King Henry VIII. Good Queen Bess did not frown on the practice either, for, in the records of her visit to Kenilworth, 1575, we read that the Earl of Leicester broached three hundred and sixty-five hogsheads of beer, besides any amount of wine.

Toward the end of her reign drinking increased, thanks to the habits acquired by the volunteers in the Low Countries; and under her successor, the stupid and pedantic Scotchman, James I, the court itself set an ugly example to the people of England. We read that, at a great feast given by the minister Cecil to the king and to a visiting monarch, Christian IV of Denmark, James was carried to the bed intoxicated, and King Christian, less fortunate, rolled around very much under the influence of liquor and grossly insulted some of the ladies present. The latter, in their turn, before the evening was through, became quite as tipsy as the men, and, according to the testimony of an eye-witness, behaved most disgracefully. The nation sobered somewhat during the next reign and under the Commonwealth, only to return again to loose habits after the Restoration. And with the accession of the Dutch King, William, in 1688, the drinking assumed a more dangerous stage than ever.

For by this time people had at last learned that alcohol was intoxicating, and had also learned how to make it cheaply out of grain. Up to the seventeenth century all the *aqua vitæ* was made from wine, and was therefore expensive. But now they were able to make it from beer; and not only in France, at Nantes and elsewhere, but in Switzerland, and especially in Holland, at Schiedam and other places, great distilleries were pouring out vast quantities of cheap and fiery spirits. Early in William and Mary's reign encouragement was given to similar distilleries in England, on the ground of assisting agriculture, and by the beginning of the eighteenth century all England was flooded with native as well as imported gin at absurdly low prices.

The results were most disastrous. London streets abounded with ginshops, and one could actually find placards on them reading, "Drunk for a penny; dead drunk for twopence; clean straw for nothing." The effects on the common people were so marked that all thoughtful persons were alarmed by it. In the wet, temperate climate of England people might drink heavily of beer or wine, and still in fair measure retain their health and their capacity for work; but, under the reign of gin, vice and misery and disease increased so fearfully that Parliament finally passed a law practically prohibiting its use.

This famous "Gin Law," passed in 1736, is interesting as the earliest severe blow at liquor dealing among civilized nations. It levied a tax of twenty shillings a gallon on spirits, and a license of fifty pounds for any one selling or dealing in it. And, being in advance of public opinion, it failed much as other, more stringent, prohibition laws have failed in our own day. For the cry was at once raised that it taxed the poor man's gin, and let the rich man's wine go free. Every wit, every caricaturist, had his fling at it. Ballads were hawked round, telling of the approaching death of Mother Gin. The liquor shops were hung with black, and celebrated uproariously Madame Geneva's lying in state, her funeral, her wake, and so on. The night before the law went into effect, so the contemporary journals say, there was a universal revel all over the country. Every one drank his fill, and carried home as much gin, besides, as he could pay for.

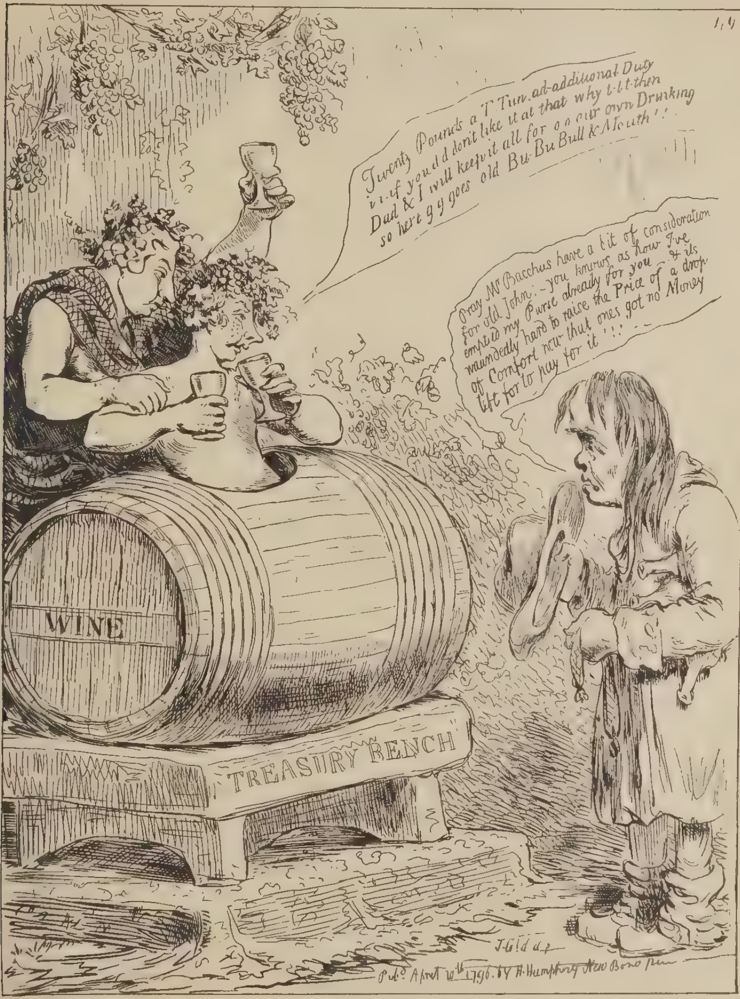
To evade the law, apothecaries sold it in vials and small packages, sometimes colored and disguised, generally under false labels, such as "Colic Water," "Make Shift," "Ladies' Delight." There were printed directions on some of these packages—e. g., "Take two or three spoonfuls three or four times a day, or as often as the fit takes you." Informers were very prominent and exceedingly offensive, inventing snares to catch lawbreakers for the sake of the heavy rewards, and spying and sneaking around in a way particularly distasteful to the English mind. In consequence, they suffered in their turn. The mere cry "Liquor spy!" was enough to raise a mob in the London streets, and the informer was lucky if he escaped with a sound thrashing and a ducking in the Thames or the nearest horse pond. Indeed, such an outcry was made about the matter that the ministry became very unpopular, and the law was not enforced after two or three years, and was largely modified in 1743, after seven years' trial.

While the lower classes in England were thus being demoralized by gin, the upper classes were suffering almost as much from the introduction of the strong, sweet, fiery, heavily brandied wines of Portugal, thanks, in part at least, to some favoring clauses in the Methuen treaty, early in the eighteenth century. It is curious to read in the contemporary journals and diaries and in the histories and descriptions of the last century—as, for instance, in Trevelyan's Life of Fox—how terribly demoralized was the state of English society during the period of England's greatest colonial and material expansion. The country was governed by a small, wealthy, land-owning aristocracy, who seemed to take the most unbridled corruption in public, and the most unrestrained dissipation in private life as a matter of course. It was from the long years of peace under the Walpoles, during the first half of the century, when the energy and industry of the middle classes were able to exert themselves, and from the protection of her insular position, that England obtained strength to master her empire, not from any superiority in her governing classes.

For, all during the last century, drunkenness was the rule, not the exception, in all classes of society. In the lower classes it was actually encouraged. Did the troops win a victory, did a prince come of age, "Go home, Jack," would say the master to his servant, "build a big bonfire, and tell the butler to make ye all drunk." It was quite a compliment to call an underling an "honest, drunken fellow." And as for the gentlefolk—well, we can hardly conceive of the state of affairs. It was part of a gentleman's education to learn to carry his port. One, two, three quarts a night was a proper and reasonable supply. After dinner the ladies retired into another room—a practice still observed—so that the men should have no embarrassing restraints, and it was a matter of course for them to drink one another under the table as fast as was convenient. In the army and navy, in the learned professions, among the gentry and nobility, and even in the royal family, heavy drinking was the rule and not the exception until well on in the present century.

THE GOUT. (Gillray.)

And they suffered from it. Their lives were shortened, their usefulness impaired, their estates squandered, and then the gout! Nowadays, with the example of Palmerston and Bismarck, Gladstone and Sherman before our eyes, it is hard to think of a time when statesmen were incapacitated at thirty-five or forty. But it was so. A gentleman who reached middle age without being crippled was either unusually lucky or was a milksop. Lord Chatham and many, nay most, of his contemporaries were horribly tortured by it. At critical periods in the nation's history a severe onset of gout, or the illness leading up to it, would cause the retirement of the most prominent statesmen. Many of them died young. Few indeed of them reached a healthy and vigorous old age. For heavy drinking was not confined to the idlers and spendthrifts, the courtiers and country gentlemen; it was a custom with the ablest and most brilliant men in England. Pitt and Fox, the two "Great Commoners," were noted topers. The old couplet is still remembered that refers to a scene in the House of


Twenty Pounds a T Tun. ad-additional Duty
i-i-if you d d dont like it at that why t-t-t-then
Dad & I will keep it all for o o our own Drinking
so here g g goes old Bu-Bu Bull & Mouth'!!
Pray Mr Bacchus have a bit of consideration for old John:-you knows as how I've emptied my Purse already for you - & its waundedly hard to raise the Price of a drop of Comfort now that ones got no Money left for to pay for it'!!!
WINE
TREASURY BENCH
J Gi'd a.p
Pub. April 10th 1796. by H. Humphrey New Bond Str

John Bull petitioning Pitt and Dundas to Lighten the Liquor Tax. (Gillray.)

Commons when Pitt and his friend Dundas came staggering in, and Pitt says: "I can not see the Speaker, Dick; can you?" "Not see the Speaker? Hang it, I see *two*." And all through the regency and well on through the next reign until the accession of the young Queen, there prevailed what to us would seem unpardonable license.

But it must not be inferred from this that drinking was much *more* prevalent in England than in other parts of the world at the same periods. Indeed, the records of Germany and Holland show quite as startling pictures. And in our own country we have not much to boast of.

The North American Indians were, on the whole, unaccustomed to alcoholic beverages before the arrival of the white man. Tobacco they had, and used it freely. In some stray localities we read of drinks made from maize; and from the reports of Captains Amadas and Barlow to Sir Walter Raleigh about the expedition to Virginia in 1584, we find that the Indians along the coast of Chesapeake Bay and the Carolinas had learned the art of making wine from grapes. But when the Puritans landed in Massachusetts in 1620 they found, to their disgust, that beer and wine were both lacking, and we find Governor Bradford complaining bitterly of the hardship of drinking water.

Nor was water a more favored beverage among the settlers of Massachusetts Bay eight or ten years later. The first list of necessities sent back to the home company, in 1629, is headed, as our New England friends have so frequently reminded us, by an appeal for "ministers," and for a "patent under seale." We do not hear so often of their request, only a line or two further down, for "vyne planters." They ask for wheat, rye, barley, and other grains, and also for "hop rootes."

The records are still kept of the equipment of the vessel sent out in answer to this appeal. It was provisioned for one hundred passengers and thirty-five sailors for three months, each sailor counting as much as two passengers. They provided for the voyage "forty-five tuns beere, at four and six shillings per tun; two caskes Mallega and Canarie at sixteen shillings; twenty gallons aqua vitæ," and—for drinking, cooking, and all, only six tuns of water!

Higginson, the well-known first minister, went out in 1628. The next year he wrote home a glowing account of the country. Among other things, the air was so fine that his health was greatly benefited. "And whereas my stomache could only digest and did require such drinke as was both strong and stale, now I can and doe oftentimes drinke New England water verie well."

This really remarkable fact we find explained a few years after by Wood, in his New England's Prospect. He says that the country is well watered, and with different water from that of England; "not so sharpe, of a fatty substance, and of a more jetty colour. It is thought that there can be no better water in the world; yet dare I not preferre it to good Beere as some have done. Those that drinke it be as healthful, fresh, and lustie as they that drinke beere."

By 1631 they had passed a law for putting drunkards in the stocks; other laws followed concerning adulterations, sale to savages, etc. In 1634 the price of an "ale quart of beere" was set at a penny, and brew houses were soon in every village, in some places attached to every farm. The manufacture of other drinks followed rapidly, and in Judge Sewall's diary, some forty or fifty years later, we find mention of ale, beer, mead, metheglin, cider, wine, sillabub, claret, sack, canary, punch, sack posset, and black cherry brandy. The commonest of all these was "cyder," which was produced in enormous quantities and drunk very freely. Sack was passing out of date, excepting in posset, a delectable mixture of wine, ale, eggs, cream, and spices, boiled together. Metheglin and mead were brewed from one part of honey and two or two and a half parts of water and spices, fermented with yeast, and very heady liquors they were. The least excess, as they used to say, would bring back the humming of the bees in the ears. Governor Bradford early issued one of his orders against some "Merrymount scamps" on board the bark Friendship, who took two barrels of metheglin from Boston to Plymouth, and "dranke up, under the name leakage, all but six gallons."

But none of these, nor the "beveridge" and "swizzle" made from molasses and water, the perry, peachy, spruce and birch beer, and the rest, did half as much execution as rum. This was introduced from Barbadoes about 1650, and from then on became practically the national drink of the country. A great trade was set up with the West Indies, the ships exporting corn and pork and lumber for the plantations, and returning with cargoes of raw sugar and molasses, which last was almost valueless where it was made, but, diluted and fermented, furnished a ready source of alcohol.

Every little New England town and village had its distillery —the seaport towns had scores of them—and the rum bullion, rumbooze, or, as it was universally known, killdivil, was sold freely for two shillings a gallon, and was shipped largely to the African coast in exchange for slaves. It was to this profitable trade that Newport and other New England coast towns owed their prosperity, and the interference with this trade by the English Commerce Acts was one of the main causes of the Revolution.

This rum was the basis not only of "flip," when mixed with beer, molasses, dried pumpkin, and sometimes cream and eggs, and stirred, before serving, with a red-hot poker, but also of punch. This latter, named after an East Indian word meaning five, was concocted with sugar, spices, lemon juice, and water, and was imbibed freely. As early as 1686 we find travelers telling of noble bowls of punch, which were passed from hand to hand before dinner. Double and "thribble" bowls there were also, holding two or three quarts each, and the amounts that our ancestors disposed of in those days are staggering.

For liquor was not only used at dinner and supper parties; it was taken morning, noon, and night, as a matter of course. The laborer would not work at the harvest, the builders at their trades, without a liberal allowance of rum. It did not matter, either, what class of work they were doing. When the little town of Medfield, early in the last century, "raised" the new meeting house, there were required "four barrels beer, twenty-four gallons West Indian rum, thirty gallons New England rum, thirty-five pounds loaf sugar, twenty-five pounds brown sugar, and four hundred and sixty-five lemons." A house could not be built without liquor being distributed at every stage of the operation, and this practice was not obsolete till well on in this century.

The clergy, while keeping a strict eye upon the excesses of their parishioners, did not disdain a drop themselves, and their conventions rivaled the dinners of the non-elect. In 1792 Governor Hancock gave a dinner to the Fusileers at the Merchants' Club in Boston, and for eighty diners there were served one hundred and thirty-six bowls of punch, twenty-one bottles of sherry, and lots of cider and brandy. But a similar bill is preserved for the refreshments at the ordination of a clergyman at Beverly, Mass., in 1785, and we notice:

30 Bowles Punch before they went to meeting	£3	0*s.*	0*d.*
80 people eating in morning, at 16*d.*	6	0	0
10 bottles of wine before they went to meeting	1	10	0
68 dinners at 30*d.*	10	4	0
44 bowles punch while at dinner	4	8	0
18 bottles wine	2	14	0
8 bowles brandy	1	2	0
Cherry Rum	1	10	0
and 6 people drank tea	0	0	9

It would be but useless repetition to discuss the drinking habits of New York and other colonies. It is enough to say that well on into the present century drunkenness was extremely common, and, when people could afford it, a most pardonable and venial offense. It is the pride of our civilization in the present century that, during the last fifty or seventy-five years, the whole tone of society has changed, and intemperance, while still unfortunately prevalent, is nothing like as common as it used to be.

Indeed, it is hardly possible for us to imagine the state of affairs in our grandfathers' times. A hundred years ago a gentleman who went out to dinner, and was not brought home in the bottom of a cab or in a wheelbarrow, was a very poor-spirited fellow indeed. So with the poorer classes. Just a century ago George Washington was engaging a gardener, and in his contract it was expressly stipulated that he should have "four dollars at Christmas, with which he may be drunk for four days and four nights; two dollars at Easter to effect the same purpose; two dollars at Whitsuntide, to be drunk for two days; a dram in the morning, and a drink of grog at dinner at noon." Nor was the sum mentioned a niggardly one, when George Washington was distilling his own whisky, and selling it, probably, for thirty or forty cents a gallon.

And now, just think of the change. We can hardly imagine a gentleman perceptibly exhilarated with wine at a dinner table. He certainly would never get a second opportunity, if the fact were known. And as for the working classes—a clerk, an engineer, a coachman, or even a gardener whose breath smelt of whisky, or who was seen often dropping into a saloon, would run a good chance of losing his position.

For the world has at last found out what intoxication means. Alcohol in large doses is a poison, but it is a poison which injures the family and neighbors and friends of the inebriate more than the victim himself. It, to some extent at least, causes him discomfort, but think of the discomfort it causes his family! It shortens his life, to be sure, but think of the other lives that it shortens! And while some attack the problem with fierce and violent denunciations, and others by quieter and not the less effective arguments and appeals, the world certainly owes a debt of gratitude to those who are doing so much now, and who have done so much already, to relieve mankind from the burden of inebriety.

THE electric telegraph cable laid five years ago between the Senegal coast of West Africa and Pernambuco, Brazil, has broken twice about one hundred and fifty miles from the African coast. On examining it for repairs, the cable was found surrounded by great quantities of vegetable growth, with refuse and rubbish of various kinds; while the color of the sea changed to a dirty brownish green, indicative of the presence of river water; yet the nearest stream was a great distance away, flowing at its point of discharge in a direction different from that of this spot. It was supposed to be a sudden outburst of a submarine gully or stream. A number of such streams or fresh-water submarine wells are known, but how gourds, pieces of orange peel, and scraps of carpets, such as were found around the cable, got into them, remains a mystery.

THE MOB MIND.

By Prof. EDWARD A. ROSS.

IN viewing social life among animals one is struck by the contagion of feeling in a herd or flock. Whatever the feeling called up, whether terror, hostility to a stranger, rage at hereditary enemies, sympathy for a stricken fellow, or the impulse to migrate, all the members of the group feel it, and feel it almost at once. If anything unusual occurs, a wave of excitement passes over the herd, followed by instant and unanimous response. Of inquiry or doubt or reflection there is no sign.

This prompt obedience to suggestions from one's fellows is accounted for the moment we recall the harsh conditions of animal existence. It is the gregarious animals that are least formidable by nature and hence most dependent on mutual aid. Instant fight or flight is the condition of their existence, and failure to coöperate promptly means death. By oft-repeated sifting out of the stupid, the heedless, or the willful, Nature builds up a marvelous suggestibility and a most alert response to sign. Not otherwise can we explain why a feeling should run like wildfire through a band of elephants or terror should strike through a herd of deer as a shock passes through a solid body.

The human analogue to the agitated herd is the mob. Mob comes from "mobile," and refers to mental state. A crowd, even an excited crowd, is not a mob; nor is an excited crowd bent on violence a mob. Great mental instability marks the true mob, and this characterizes only the crowd that is under the influence of suggestion. A lynching party may be excited, disorderly, and lawless, yet not be a true mob. The crowd that lynched thirteen Italians in New Orleans a few years ago, far from showing the wavering indecision of the genuine mob, seemed to know exactly what it wanted and just how to go about it. In this respect it stood in high contrast to the Cincinnati mob of 1886. What distinguished the New Orleans crowd was the absence of epidemic. Its perfect unanimity came not from an overmastering suggestion, but from the coming together of all who had been affected with the same grim rage at the news of Chief Hennessey's assassination.

Again, we must refuse the name "mob" to the disorderly masses that in times of tumult issue from the criminal quarters of great cities. In such cases there is an unchaining in each man of the evil and secret lusts of his heart on observing that opportunity is favorable and that others are like-minded. Safe from punishment or shame, the ragamuffin or hoodlum burns, loots, and riots in obedience not to a common impulse but to his natural inclination. It is this peculiar effect of numbers in bringing on the criminal mood that chiefly marks off the human crowd from the animal crowd.

More than any other animal, man is restrained by a morality founded not on impulse but on discipline. Animal morality is mainly the prompting of fellow-feeling. But by the long pressure of an artificial environment man is brought to submit himself to the constant sway of a moral code often quite alien to his impulses. Remove the fear of consequences by the anonymity of the crowd, take away the sense of personal responsibility by the participation of numbers, and people will step by step descend into depths of evil-doing and violence that measure how far their prevailing inclinations lie below the moral standard which social pressure has forced upon them. Animals, because they have been less *moralized* than men by education, rarely show any such collective *demoralization.*

A *one-mindedness,* therefore, the result not of reasoning or discussion or coming together of the like-minded, but of *imitation,* is the mark of the true mob. We think of the mob as *excited* simply because it is under stress of excitement that men become highly imitative. *Fickleness* and *instability* characterize it simply because mood changes promptly with every change in the nature of the suggestion. It is *irrational* because dominated not by the remembered teachings of experience but by the fleeting impressions of the moment. It is *cowardly* because its members, actuated not by stern purpose or set resolve but by mere suggestion, scatter in craven flight the moment the charm is broken. It is *transitory* because the orgy of excitement leads to fatigue and lessened power of response to stimuli from without. In a few hours the hyperæsthesia wears away, physical wants and sensations turn the attention inward, the psychic bond is broken, and the crowd disperses and goes home. A mob, then, defined for purposes of social psychology, is *a crowd of people showing a unanimity due to mental contagion.* Other traits of the mob of which much is made—such as ferocity, shamelessness, criminality, courage, intolerance, etc.—need not flow from suggestion at all. More often, as I have pointed out, they are the effect of the sense of numbers.

Analyzing the mob as thus defined, we find at the base of it that mental quality termed *suggestibility* which comes to light in gregarious animals, children, certain lunatics, hysterical patients, and hypnotized subjects. It dominates childhood, but fades as character sets and the will hardens. In adult life it is so overborne by habit and reason as to be dominant only under abnormal conditions such as disease, fascination, or excitement.

Why, now, should this quality be heightened when one is in the midst of a crowd ?

The inhibitive power which measures our ability to go our own way undisturbed grows with the variety and number of suggestions that reach us. This may be because conflicting suggestions block each other off. The power of independent choice seems to develop best when the clash of suggestions reduces to a minimum the ascendency of the outer world over the individual. This is why age, travel, and contact with affairs build up character. But when numerous identical suggestions beset one, one's power of resistance is gradually undermined. As many taps of a hammer fracture the bowlder, so the onset of multitudinous suggestion breaks the strongest will. Men who can readily throw off the thousand suggestions of everyday life will be quite swept away by the reiteration of a single idea from all sides. As a mighty organ compels even benches and windows to vibrate in unison with it, so the crowd dominated by a single mood emits a volume of suggestion that gives an emotional pitch and tone to every individual in it.

Besides the volume of suggestion possible in a crowd, there is usually a condition of excitement or expectancy. Frequently, too, there is a pressure on the body which prevents voluntary movement while conveying promptly to each all those electrifying swayings and tremors that express the emotions of the mass. The mere physical contact in the excited crowd, therefore, provides certain conditions of suggestibility.

A cross-section of the mob sometimes shows a concentric structure. There is in the center a leader from whom suggestions proceed. These, caught up by those near by and most dominated by his personality, are transmitted to the next circle with an added force. Thus the suggestion passes outward from zone to zone of the crowd, at each stage gathering volume and hence power to master the rest. That, therefore, which started at the center as fascination becomes sheer mental intimidation at the rim. This symmetrical type of mob has led some to look in every case for the *leader* who controls the mass by his personality or prestige. But the quest for a nucleus, while it makes the study of mobs more mysterious and sensational, certainly does not make it more scientific. Rarely does the primitive impulse proceed from one man. Usually the first orientation of minds is brought about by some object, spectacle, or event. This original phase, the moment it is observed by the members of the crowd, gives rise to three results: (1) By mere contagion the feeling extends to others till there is complete unanimity; (2) each feels more intensely the moment he perceives that the rest share his feeling; (3) the perceived unison calls forth a sympathy that makes the next agreement easier, and so paves the way for the mental unity of the crowd.

The mob is thus a formation that takes time. In an audience falling under the spell of an actor or an orator, a congregation developing the revival spirit, a crowd becoming riotous, or an army under the influence of panic, we can witness the stages by which the mob mood is reached. With the growing fascination of the mass for the individual, his consciousness contracts to the pin point of the immediate moment, and the volume of suggestion needed to start an impulse on its conquering career becomes less and less. In the end, perhaps, any commanding person can assume the direction of the mob.

It must be manifest, however, that there are a hundred cases of imitation of the many for one case where the entire mass throughout obeys a single person. In accounting for the mob, hypnosis has no such scope of application as the theory of mental intimidation. If we suppose that the eye of the leader or the gesture of the orator paralyzes the will of the crowd as the "bright object" of the hypnotizer overcomes his subject, we shall not get the mob without *presence*. But if the secret of its unanimity lies in mass suggestion, why is presence necessary? May there not be mob phenomena in a multitude of people not collected at one spot within sight and sound of each other?

It has long been recognized that the behavior of city populations under excitement shows the familiar characteristics of the mob quite apart from any thronging. Here we get unanimity, impulsiveness, exaggeration of feeling, excessive credulity, fickleness, inability to reason, and sudden alternations of boldness and cowardice. In fact, if you translate these qualities into public policy, you have the chief counts in the indictment which historians have drawn against the city democracies of old Greece and mediæval Italy.

These faults are due in part to the nervous strains of great cities. The continual bombardment of the attention by innumerable sense impressions is known to produce neurasthenia or hysteria, the peculiar malady of the city dweller. Then, too, there thrive in the sheltered life of the city many mental degenerates that would be unsparingly eliminated by the sterner conditions of existence in the country. But aside from this the behavior of city dwellers under excitement can best be understood as the result of mental contacts made possible by easy communication. While the crowd, with its elbow-touch and its heat has no doubt a maddening all its own, the main thing in it is the contact of minds. Let this be given, and the three consequences I have pointed out must follow. An expectant or excited man learns that a thousand of his fellow-townsmen have been seized by a certain strong feeling, and meets with their expression of this feeling. Each of these townsmen learns how many others are feeling as he does. Each stage in the consequent growth of this feeling in extent and in intensity is perceived, and so fosters sympathy and a disposition to go with the mass. Will we not inevitably by this series of interactions get that "out"-look which characterizes the human atom in the mob?

The bulletin, the flying rumor, "the man in the street," and the easy swarming for talk or harangue open those paths between minds, and prepare those contacts that permit the ambient mass to press almost irresistibly upon the individual. But why will this phenomenon be limited to the people huddled on a few square miles of city ground? Mental touch is not bound up with proximity. With the telegraph to collect and transmit the expressions and signs of the ruling mood, and the fast mail to hurry to the eager clutch of waiting thousands the still damp sheets of the morning daily, remote people are brought as it were into one another's presence. Through its organs the excited public is able to assail the individual with a mass of suggestion almost as vivid as if he actually stood in the midst of an immense crowd.

Formerly, within a day a shock might throw into a fever all within a hundred miles of its point of origin. The next day it might agitate the zone beyond, but meanwhile the first body of people would have cooled down and would be disposed to listen to reason. And so, while a wave of excitement passed slowly over a country, the entire folk mass was at no moment in the same state of agitation.

Now, however, our space-annihilating devices, by transmitting a shock without loss of time, make it all but simultaneous. A vast public shares the same rage, alarm, enthusiasm, or horror. Then, as each part of the mass becomes acquainted with the sentiment of all the rest, the feeling is generalized and intensified. A rise of emotional temperature results which leads to a similar reaction. In the end the public swallows up the individuality of the ordinary man, as the crowd swallows up the will of its members.

It is plain that in matters of policy this instant consensus of feeling or opinion works for ill if it issues in immediate action. Formerly the necessary slowness of focusing and ascertaining the common will insured pause and deliberation. Now the swift appearance of a mass sentiment threatens to betray us into hot-headed or ill-considered measures. Sudden heats and flushes take the place of reflection and resolve; and with this comes a growing impatience with the checks and machinery that prevent the public from giving immediate effect to its will. As the working of representative government thus becomes less clumsy, there disappears some of that wholesome deliberateness which has distinguished indirect from direct democracy.

Mob mind working in vast bodies of dispersed individuals gives us the *craze* or *fad*. This may be defined as *that irrational unanimity of interest, feeling, opinion, or deed in a body of communicating individuals which results from suggestion and imitation.* In the chorus of execration at a sensational crime, in the clamor for the blood of an assassin or dynamiter, in waves of national feeling, in war fevers, in political "landslides" and "tidal waves," in passionate "sympathetic" strikes, in cholera scares, in public frights, in popular delusions, in religious crazes, in "booms" and panics, in agitations, insurrections, and revolutions, we witness contagion on a gigantic scale, favored in some cases by popular hysteria. It is best to keep the term "craze" for an imitative unanimity arrived at under great excitement, while "fad" is that milder form of imitation which appears in sudden universal interest in some novelty.

As there must be in the typical mob a center which radiates impulses by fascination till they have subdued enough people to continue their course by sheer intimidation, so for the craze there must be an excitant, overcoming so many people that these can affect the rest by mere volume of suggestion. This first orientation is produced by some event or incident. The murder of a leader, an insult to an ambassador, the sermons of a crazy fanatic, the words of a "prophet" or "Messiah," a sensational proclamation, a scintillating phrase, the arrest of an agitator, a *coup d'état,* the advent of a new railroad, the collapse of a trusted banking house, a number of deaths by an epidemic, a series of mysterious murders, and an inexplicable occurrence such as a comet, an eclipse, a star shower, an earthquake, or a monstrous birth—each of these has been the starting point of some fever, mania, crusade, uprising, boom, panic, delusion, or fright. The more expectant, overwrought, or hysterical is the public mind, the easier it is to set up a great perturbation. Even clergymen noted a connection between the "great revival" of 1858 and the panic of 1857. After a series of public calamities, a train of startling events, a pestilence, earthquake, or war, the anchor of reason finds no "holding ground," and minds are blown about by every breath of passion or sentiment.

The fad originates in the surprise or interest excited by novelty. Roller-skating, blue glass, the planchette, a forty days' fast, the "new woman," tiddledy-winks, faith-healing, the "13–14–15" puzzle, baseball, telepathy, or the sexual novel attract those restless folk who are always running hither and thither after some new thing. This creates a swirl which rapidly sucks into its vortex the soft-headed and weak-minded, and at last, grown bigger, involves even the saner kind. As no department of life is safe from the invasion of novelty, we have all kinds of fads: literary fads like Maeterlinck or the Decadents; philosophic fads like pessimism or anarchism, religious fads like spiritualism or theosophy; hygienic fads like vegetarianism, "glaming," "fresh air," mush diet, or water cure; medical fads like lymph, tuberculin, and serum; personal fads like short hair for women, pet lizards, face enamel, or hypodermic injections of perfumery. And of these orders of fads each has a *clientèle* of its own.

In many cases we can explain vogue entirely in terms of novelty fascination and mob mind. But even when the new thing is a step in progress and can make its way by sheer merit, it does not escape becoming a fad. It will have its penumbral ring of imitators. So there is something of the fad even in bicycling, massage, antisepsis, skiagraphy, or physical culture. Indeed, it is sometimes hard to distinguish the fad from the enthusiastic welcome and prompt vogue accorded to a real improvement. For the uninitiate the only touchstone is time. Here as elsewhere "persistence in consciousness" is the test of reality. The mere novelty, soon ceasing to be novel, bores people and must yield to a fresh sensation; the genuine improvement, on the other hand, meets a real need and therefore lasts.

Unlike the craze, the fad does not spread in a medium specially prepared for it by excitement. It can not rely on heightened suggestibility. Its conquests, therefore, imply something above mere volume of suggestion. They imply prestige. The fad owes half its power over minds to the prestige that in this age attaches to the new. Here lies the secret of much that is puzzling.

The great mass of men have always had their lives ruled by usage and tradition. Not for them did novelties chase each other across the surface of society. The common folk left to the upper ten thousand the wild scurry after ruling fancy or foolery of the hour. In their sports, their sweethearting, their mating, their child-rearing, their money-getting, their notions of right and duty, they ran on quietly in the ruts deeply grooved out by generations of men. But a century or so ago it was found that this habit of "back"-look opposed to needed reforms the brutish ignorance, the crass stupidity, and the rhinoceros hide of bigotry of the unenlightened masses. Accordingly, the idea of the humanitarian awakening that accompanied the French Revolution was to lift the common folk—the third estate—from the slough of custom to the plane of choice and self-direction. And for a hundred years the effort has been to explode superstition, to diffuse knowledge, to spread light, and to free man from the spell of the past and turn his gaze forward.

The attempt has succeeded. The era of obscurantism is forever past. With school and book and press progress has been taught till with us the most damning phrase is "Behind the times!" But we now see that a good deal of the net result has been to put one kind of imitation in place of another. Instead of aping their forefathers, people now ape the many. The multitude has now the prestige that once clothed the past. Except where rural conservatism holds sway, mob mind in the milder forms of fad and craze begins to agitate the great deeps of society.

Frequently a half-education has supplied many ideas without developing the ability to choose among them. The power to discriminate between ideas in respect to their value lagging far behind the power to receive them, the individual is left with nothing to do but follow the drift. Ideas succeed one another in his mind not by trial and rejection, but in the order of their arrival on the scene. Formerly people rejected the new in favor of wont and tradition; now they tend to "go in" for everything, and atone for their former suspiciousness by a touching credulity. The world is abuzz with half-baked ecstatic people who eagerly champion a dozen different reforms in spelling, dress, diet, exercise, medicine, manners, sex relations, care of children, art, industry, education, and religion, each of which is to bring in the millennium all at once.

These minds that, broken from the old moorings of custom, drift without helm or anchor at the mercy of wind and tide, are social derelicts. They follow the currents of opinion; they can not create them. At all times ripples chase each other over the surface of society in the direction of improvement—sudden but all-pervading interest in "how the other half lives," in the abolition of war, in rational dress, in out-of-door sports, in "a white life for two." Had these ripples a real ground swell beneath them, the world might soon be made over. But, alas! they are only ripples. They wrinkle the surface of people's attention for an instant, but in a moment their fickle minds are responding to a new impulse in a different direction.

If this were to be the outcome of the attempt to emancipate the common man and fit him to be helmsman of society, we might well despair. Certainly the staid, slow-going man of olden times, plodding along the narrow but beaten path of usage, is as dignified a figure as the unsteady modern person whose ideas and preference flicker constantly in the currents of momentary popular feeling. The lanes of custom are narrow; the hedgerows are high, and view to right or left there is none. But there are as much freedom and self-direction in him who trudges along this lane as in the "emancipated" man who finds himself on an open plain, free to go in any direction, but nevertheless stampedes aimlessly with the herd.

The remedy for mob mind, whether presented in the liquefaction of our city folk under modern conditions of mental intimacy or in the mad rush of the public for the novelty of the hour, is not in replanting the hedgerows of custom. We must go forward, keeping in mind, however, that the chief present need is not to discredit the past but to discredit the mass. The spell of ancestors is broken; let us next break the spell of numbers. Without lessening obedience to the decision of majorities, let us cultivate a habit of doubt and review. In a good democracy blind imitation can never take the place of individual effort to weigh and judge. The frantic desire of frightened deer or buffalo to press to the very center of the throng does not befit civilized man. The huddling instinct has no place in strong character. Democracy's ideal is a society of men with neither the "back"-look on the past nor yet the "out"-look on their fellows, but with the "in"-look upon reason and conscience. We must hold always to a sage Emersonian individualism, that, without consecrating an ethics of selfishness, a religion of dissent, or a policy of anarchism, shall brace men to stand against the rush of the mass.

ARE SCORPIONS MATRICIDES AND SUICIDES?

By Dr. JUAN VILARÓ,

PROFESSOR OF NATURAL HISTORY, HAVANA UNIVERSITY; FISH COMMISSION'S NATURALIST.

IT is by no means a rare thing to see a simple coincidence designated and accepted as a cause. Such is the case with the erroneous though common and deep-rooted belief that the newly born scorpions devour their mother during the first period of their life. Science has dispelled this vulgar error, as it has done away with the absurd assertions about the *vegetating wasp* and other species of animals.

It is a well-known fact that the little scorpions, when they come into life, place themselves at the sides and upon the back of their mother, where they remain huddled together while their transformation is being completed, or, in other words, until they change their first skins (exuviation or ecdysis).

At this moment the little scorpions break away and commence *on their own hook* their lively search for food, thus entering the wide field of the struggle for existence.

During this period of their life the mother may die. The difficult and hazardous process of delivery is oftentimes the cause of such death. The ants hasten to do away with the remains, and this is the origin of the common but erroneous belief that the mother has fallen a victim to the voracity of her own offspring.

As I have always been impressed by the grandeur of small things, and as phenomena of apparent insignificance are often of great importance, I resolved to find out the truth through my own experiments, with the following results:

A few years ago I introduced into a capacious flask a she scorpion with her offspring of fifty little scorpions. They lost no time in regaining their position upon the mother's back, to which they regularly returned every time they were forcibly dislodged. In order to excite the voracity of the little ones, I withdrew all food from their reach, and even mutilated one of the mother's legs. The hæmorrhage thus produced failed to give the result hoped for. The fifty little scorpions changed their skins and subsequently died of hunger. The mother came out unscathed. I repeated the experiment upon a later occasion, in Jamaica, placing together two different breeds upon one mother's back. The weak little scorpions died, as was to be expected, of starvation, and I vainly tried to provoke their voracity with the mother's blood.

Rock Scorpion.

But if science has exonerated scorpions from the horrible crime of matricide, it is by no means so clear that they are entirely deprived of the faculty of maiming themselves, and even of making attempts on their own life, an inclination which they possess in common with many other animals.

The assertion that scorpions, when surrounded by fire and deprived of all means of escape, commit suicide, was first advanced by Paracelsus. Some naturalists delare this to be a fact, while others deny it. Among the latter we may count Brehm, who, while acknowledging that the scorpion when thus tortured does sometimes commit suicide, does not believe it is intentional. "Nature," says Brehm, "has set apart man as the only being, in all creation, who under certain circumstances enjoys the dire privilege of destroying *his own self*." My own observations and experiments, carried out in July, 1881, at the sugar estate "Osado de Lagunillas," jurisdiction of Cardenas (Cuba), in the presence of several relatives and friends, authorize me to assert that the scorpion, after repeatedly attempting to emerge from the circle of fire by which it is surrounded, drawing its cheliform appendages toward its mouth whenever they come in contact with the fire, wounds itself with its own sting in the place called by Flourens the vital point, instantly dying.

I may add that the same experiment has been performed, with identical results, on specimens of different ages, sex, and strength by persons who are wholly deserving of my confidence.

E. Blanchard, Paul Bert, Jousset de Bellesme, and Joyeux-Laffine have studied the poisonous apparatus of the scorpion and the effects resulting therefrom.

The toxic matter is a transparent liquid of acid reaction, which dries easily, is readily dissolved in water, and insoluble in absolute alcohol and ether.

"The scorpion's poison," says Joyeux-Laffine, "is very active, although it lacks all the toxic strength which some authors have attributed to it. Its effects are directly proportionate to the quantity introduced into the system. One drop of this poison in a pure state, or even mixed with a small quantity of water, is sufficient to produce instant death when injected into the cellular tissue of a rabbit. Birds succumb to it as readily as mammals. One drop of this poison is sufficient to kill seven or eight frogs. Fish, and especially mollusks, are not so susceptible. The articulates, however, are surprisingly affected by this poison; the one hundredth part of a drop suffices to kill a good-sized crab. The flies, spiders, and insects upon which the scorpion feeds are, so to speak, fulminated by the sting of this animal."

THE doctrine of multiple souls among the Calabar negroes is described by Miss Kingsley as including the notion of four souls—the soul that survives death, the shadow on the bush, the dream soul, and the bush soul. The bush soul is detachable from the body, but if damaged or killed in its wanderings the body suffers the same fate. Hence old people are held in respect, even if known to be wicked, because their bush souls must be particularly powerful and astute. The soul that survives death is liable to reincarnation either in a higher or lower form. The dream soul is the particular care of witches, who lay traps for it and return it to the owner on payment.

SKETCH OF HORATIO HALE.

GREAT advances have been made by ethnologists of the present generation in the study of the languages of the American aborigines and in the investigation of primitive linguistics. The pioneer in these researches, one whose efforts have been among the most fruitful, the one who perhaps has so far gone deepest into the investigation, was Horatio Hale, who died at Clinton, Ontario, December 29, 1896. "By his death," says his fellow-student in this subject, Dr. Franz Boas, in The Critic, "ethnology has lost a man who contributed more to our knowledge of the human races than perhaps any other single student." The sketch that follows was carefully prepared nearly two years before Mr. Hale's death. Although a few changes of form might have been proper to adapt it to the present date, we prefer to publish it as it was left, only inserting a few words respecting Mr. Hale's distinguished mother.

HALE, HORATIO, M. A., ethnologist and lawyer, was born on May 3, 1817, at Newport, N. H. His father, David Hale, was a leading lawyer of that town, and his mother, Sarah Josepha, after her husband's death in 1822, became well known in American literature as a highly esteemed author and editor. [Her nursery poem, Mary had a Little Lamb, has endeared her to children's hearts, and other fugitive productions of hers have become widely familiar. She was for one year less than a half century editor of the Ladies' Magazine, Boston, and, after its merger in that periodical, of Godey's Ladies' Book, Philadelphia, which had an immense circulation for its day and was a living force in shaping the tastes and aims of American women. She was one of the earliest advocates of the advancement and higher education of women, and was the virtual founder of the engagement of women in foreign missionary service and of the Woman's Union Missionary Society for heathen lands. Through her urgency the women of New England contributed fifty thousand dollars toward the completion of the Bunker Hill Monument; and mainly through her urgency and correspondence with Governors of States and Presidents of the United States Thanksgiving Day was made a national festival.] Their son showed an early inclination for the study of languages, and particularly of the Oriental and aboriginal American tongues. At the age of sixteen he entered Harvard College. In the following year, when a party of Indians from Maine came to Massachusetts and encamped for a time on the college grounds, he took the opportunity of collecting a vocabulary of their dialect. This, with some accompanying remarks, was printed in 1834 in a small pamphlet, which was distributed among scholars interested in linguistic science. As a result of this and other like evidences of qualification he was appointed in 1837, the year of his graduation from the university, to the office of philologist and ethnographer in the United States Exploring Expedition to the Pacific, under Captain (afterward Admiral) Charles Wilkes. The expedition occupied the years from 1838 to 1842. Mr. Hale's report on Ethnography and Philology, composing the seventh volume of the expedition series, and filling nearly seven thousand quarto pages, appeared in 1846. It is devoted to the physical and mental characteristics, the customs, and the languages of the natives of the Pacific islands (including Polynesia, Micronesia, and Melanesia), and of Australia, northwest America, Patagonia, and southern Africa. The eminent ethnologist, Dr. R. G. Latham, in the preface to his work on The Natural History of the Varieties of Man (1890), describes the contents of Mr. Hale's volume as "the greatest mass of philological data ever accumulated by a single inquirer." He quoted from it freely, as does also Prof. Max Müller in his Lectures on the Science of Language (second series), where he refers particularly to the "excellent Polynesian grammar."

The two portions of this volume which attracted most attention at the time of its publication, and have since most materially influenced the sciences to which it related, are the section which treats of the migrations of the oceanic islanders and that which is devoted to the tribes of northwestern America. The first of these sections, by a large accumulation of traditional and linguistic evidence, determined the origin of the Polynesians from a single island of the Malaisian Archipelago, and fixed not only the probable time and place of their first appearance as emigrants in the Pacific Ocean, but also the period of their settlement in each of the principal groups, showing that both the original migration and the subsequent dispersion were events of comparatively recent occurrence, probably beginning but little before the Christian era, and that the dispersion was, in fact, still going on in our century. The other portion made known for the first time the extraordinary number and variety of languages in northwestern America. The "ethnographical map" prepared by the author showed in what was then the Oregon Territory, comprising the present States of Oregon and Washington, no less than thirty languages and dialects, belonging to twelve distinct stocks, differing totally from one another in both vocabulary and grammar. This is more than twice the number of stocks that are found in the whole of Europe. These and other similar facts led to a theory afterward proposed by Mr. Hale to explain them, as will presently be recorded.

After the publication of this report Mr. Hale spent a few years in foreign travel and in the study of law, and in 1855 was admitted to the bar of Illinois at Chicago. In the following year he removed with his family to Canada West, taking up his abode in the then newly formed town of Clinton, on an estate which had descended to his wife, a lady of Anglo-Canadian birth. Here he has since devoted his time partly to professional pursuits and to local undertakings of public utility, and partly to scientific researches. For the latter, an ample field was found among the Indians inhabiting the many "reserves" which the considerate legislation of the various provinces has set apart for them. One of the most important of these is the "Six Nations' Reserve," near Brantford, occupied by about three thousand Indians, mostly Iroquois, but with several groups belonging to other stocks. Here he had the good fortune of discovering two native manuscripts in different Iroquoian dialects—Canienga (or Mohawk) and Onondaga—one of them dating from about the middle of the last century (soon after the language was reduced to writing by the missionaries), which proved to be of much historical and ethnological interest. They gave an account of the renowned confederation of the Five (afterward Six) Nations, or Iroquois tribes, which was formed about four hundred years ago, under the celebrated Onondaga chief Hiawatha. This great chief and lawgiver, whom Longfellow, following Schoolcraft's lead (though well aware of the absurd misapplication of the name), has transported to the shores of Lake Superior and converted into an Ojibway hero of romance, was a genuine historical personage, as authentic as Alfred or Washington. At the request of the distinguished ethnologist, Dr. D. G. Brinton, Mr. Hale prepared a translation of these manuscripts, which was published in 1883 in Dr. Brinton's well-known Library of American Aboriginal Literature, with several introductory chapters on the history, customs, and character of the Iroquois people, the whole forming an octavo volume of about 220 pages. Of this work, which is entitled The Iroquois Book of Rites, the eminent historian and philologist, Dr. J. G. Shea, has said: "It is a philosophical and masterly treatise on the Iroquois league and the cognate tribes, their relations, language, mental characteristics, and policy, such as we have never before had of any nation of this continent." The American Journal of Philology adds: "Mr. Hale's book is likely to make an epoch in North American Indian history, giving as it does a clearer insight than we have had before into the political constitution and fortunes and the personal character of the famous 'Six Nations,' who played so prominent a part in the land before and during the Revolutionary War."

On the same reserve Mr. Hale made another notable discovery. He had heard that there was living on the reserve an Indian of great age—reputed, indeed, to be over a century old—who was believed to be the last full-blooded survivor of the once numerous Tutelo tribe. This tribe formerly inhabited Virginia and North Carolina, and migrated thence in the last century to Pennsylvania and New York, where they united with the Iroquois "nations," and finally removed with them to Canada. Mr. Hale visited this old man, and obtained from him and some intelligent half-castes (of Tutelo-Iroquois origin) an extensive vocabulary of their language, with many historical facts, which showed them to be beyond question members of the great Dakota (or Siouan) stock of the far West. It also appeared that other tribes near them spoke the same language. The fact that septs of their wide-spread family anciently dwelt east of the Alleghanies, and in all probability occupied this North Atlantic portion of the continent before its invasion by the Iroquois and Algonkin tribes, was an important and unexpected addition to aboriginal history. The particulars of this discovery were given in a paper of considerable length, entitled The Tutelo Tribe and Language, which appeared in the Proceedings of the American Philosophical Society of Philadelphia, and was thence reprinted in pamphlet form. It naturally aroused much interest among American ethnologists.

In 1882 Mr. Hale, as a member of a committee of the American Association for the Advancement of Science, which met in that year in Montreal, took part in organizing the first meeting of the Section of Anthropology in that association; and, somewhat remarkably, two years later in the same city he was one of the committee of the British Association which organized the first meeting of the like section in that world-renowned society. These facts afford evidence both of the recent rise and progress of this branch of science and of the position held by Mr. Hale among its cultivators. At this meeting of the British Association a proposal of the first president of the new section, the distinguished anthropologist, Dr. E. B. Tylor, resulted in the appointment of a committee "to investigate the physical character, languages, and industrial and social condition of the Northwestern tribes of the Dominion of Canada." Of this committee Mr. Hale was a member, having among his colleagues the late eminent President of Toronto University, Sir Daniel Wilson, and Dr. G. M. Dawson, of the Geological Survey of Canada. In compliance with the unanimous request of his colleagues, Mr. Hale undertook the office of director of the investigations and editor of the reports—an office which, under the rules of the association, involved his temporary withdrawal from the committee. Of these reports eight have already appeared, and another, designed to be the final report, is now (January, 1895) in course of preparation. The first report, which was on the Tribes of the Blackfoot

Confederacy (who, though belonging to the Algonkin family, may from their character and achievements be styled the Iroquois of the Northwest), was prepared by Mr. Hale, partly from his own minutes, gathered in Oregon in former years, and partly from materials supplied by his correspondence with two highly esteemed missionaries, Catholic and Methodist—the Rev. Father Albert Lacombe and the Rev. Dr. John McLean. This report was presented in 1885, and proved of so much interest that before it appeared in the association's volume it was published in the English periodical Nature, and was thence reprinted in the American Popular Science Monthly. In this report, as well as in his annotations on the third report, prepared partly by his experienced collaborator, the Rev. E. F. Wilson (well known as the founder of the Shingwauk Home at the Sault Ste. Marie), Mr. Hale sought to show that the remarkable superiority of the Blackfoot Indians to the other Algonkins is due to an admixture of blood with the Kootenays of British Columbia, whose singular mental endowments are set forth in two of the subsequent reports, the sixth and eighth. All the reports after the third, with the exception of the eighth, which is by Dr. A. F. Chamberlain, formerly of Toronto University and now of Clark University, Worcester, Mass., have been prepared by Dr. Franz Boas, formerly editor of Science, who, like Mr. Wilson and Dr. Chamberlain, was invited by Mr. Hale to carry on the investigations. The reports, usually prefaced by introductory remarks of the editor, have been of considerable length, some of them comprising many pictorial illustrations, and have proved a conspicuous feature of the recent volumes of the British Association. They have been considered of so much importance that the Canadian Parliament has twice supplemented by considerable money grants the sums liberally appropriated for the committee's work by the British Association. The fifth report contained a colored "linguistic map" of British Columbia, prepared at Mr. Hale's suggestion, and supplementing his ethnographical map of Oregon, already noticed. This British Columbian map showed five linguistic stocks, additional to the twelve stocks comprised in the Oregon map, thus evidencing the existence of no less than seventeen language families in an area not larger than the British Islands. This remarkable fact, with some similar instances in other parts of the world, offered one of the most perplexing enigmas of philological science.

This enigma Mr. Hale undertook to solve in an address delivered in 1886 before the Section of Anthropology in the American Association for the Advancement of Science, of which association he had been elected one of the vice-presidents and chairman of that section. The address was on The Origin of

Languages and the Antiquity of Speaking Man. In this essay he maintained that the human race, when first endowed with articulate language, was necessarily of one community and one speech, and that the origin of the various linguistic stocks is due to a force which is in constant activity, and which may be styled "the language-making instinct of very young children." Many instances of languages thus spontaneously created by children were given; and in a later paper on the Development of Language, read before the Canadian Institute of Toronto, in 1888, as a sequel to the address, and published in the Journal of the Institute and afterward separately, further evidence was produced to show that the words and grammar of such languages might, and in many cases probably would, be totally different from those of the parental speech. In the original address the fact was pointed out that in the first peopling of every country, when, from various causes, families must often be scattered at wide distances from one another, many cases must have occurred where two or more young children of different sexes, left by the death of their parents to grow up secluded from all other society, were thus compelled to frame a language of their own, which would become the mother-tongue of a new linguistic stock. It is evident that, along with their new language, these children and their descendants would have to devise a new religion, a new social policy, and in general new modes of life, except in so far as reminiscences of the parental example and teachings might direct or modify the workings of their minds. All these conclusions, it is affirmed by Mr. Hale, in his Introduction to the Committee's Sixth Report to the British Association, "accord precisely with the results of ethnographical investigations in America."

He further maintained that while, according to the evidence adduced by geologists, we must believe that a being who had the form and some of the faculties of man (including probably some partly developed power of speech) existed in the Quaternary era, many thousands and perhaps many ten thousands of years ago, all the evidence points to the conclusion that social man, of the existing species, fully endowed with the human faculties, including that of articulate speech, appeared only some seven or eight thousand years back; and, further, that when "speaking man" thus appeared, his mental like his physical capacity—though, of course, not his knowledge—was fully equal to the capacity of any of his descendants.

The solution thus offered of the linguistic problem was received with more prompt and general favor than is usually accorded to novel theories. Prof. Abel Hovelacque, well known as one of the most eminent philologists and ethnologists of Europe, and now the official director of the School of Anthropology in Paris, reviewed the address of 1886 at length in the periodical *L'Homme* for September of that year, and, while dissenting from some of its physiological suggestions recommended the philological conclusion very strongly to the attention of scholars. Prof. Sayce, in his presidential address of 1887 to the Section of Anthropology in the British Association, spoke in equally commendatory terms, merely asking for some additional evidence, which the author of the theory endeavored to supply in his Canadian Institute paper already referred to. Prof. G. J. Romanes, in his Mental Evolution of Man, quotes largely from Mr. Hale's address—to the extent of nearly a fourth part of the whole essay—accepting the author's conclusions and fortifying them by other evidence. Prof. Henry Drummond, in his recent work, The Ascent of Man, takes a similar view. Lastly, Dr. Brinton, in his important work on Races and Peoples (which he dedicates to Mr. Hale), has given his opinion on the subject in clear and decided terms. "Those convolutions of the brain" (he writes) "which preside over speech being once developed, man did not have to repeat his long and toilsome task of acquiring linguistic faculty. Children are always originating new words and expressions, and if two or three infants are left together, they will soon have a tongue of their own, unlike anything they hear around them. Numerous examples of this character have been collected by Mr. Hale, and upon them he has based an entirely satisfactory theory of the source of that multiplicity of language which we find in various parts of the globe."

In 1889 Mr. Hale was elected a Fellow of the Royal Society of Canada. To their translations he contributed, in 1891, a paper entitled Language as a Test of Mental Capacity. This essay was also separately reprinted, with the additional title of An Attempt to demonstrate the Tone Basis of Anthropology, and attracted hardly less attention from ethnologists than his address of 1886. It received from the Anthropological Institute of Great Britain and Ireland the unusual compliment of being republished in full in their quarterly journal—despite its length of thirty-six quarto pages. It was also reprinted in four sections in successive numbers of The American Antiquarian for the following year, under the title of Man and Language. A review of this paper in Nature (June 30, 1892)—anonymous, but bearing clear evidence of the style of Prof. Max Müller—speaks of Mr. Hale as "the Nestor of American philologists, and, at the same time, the Ulysses of comparative philology in that country," and of his paper as "an important essay." The eminent reviewer adds: "All his contributions to American ethnology and philology have been distinguished by their originality, accuracy, and trustworthiness. Every one of them makes a substantial addition to our knowledge, and, in spite of the hackneyed disapproval with which reviewers receive reprints of essays published in periodicals, it is much to be regretted that his essays have never been published in a collected form." In the North American Review for July, 1892, the distinguished President of McGill University, Sir J. William Dawson, refers to this "remarkable paper of Mr. Hale's" as "one which should commend itself to the study of every biblical scholar and archæologist." He adds: "In this paper Mr. Hale maintains the importance of language as a ground of ethnological classification, and there was his wide knowledge of the languages of American aborigines and other rude races to show that the grammatical complexity and logical perfection of those languages imply a high intellectual capacity in their original framers. . . . On similar grounds he shows us that it is not in the outlying barbarous races that we are to look for truly primitive man, since here we have merely degraded types, and that the primitive centers of man and language must have been in the old historic lands of western Asia and northern Africa."

In 1893 Mr. Hale was elected President of the American Folklore Society. He had previously contributed to the society's quarterly journal a series of articles on Huron Folklore from materials gathered in his visit to the "Underdon Reserve," on the Detroit River opposite to southern Michigan—the reserve appropriated to the small band of Wyandot Indians, less than a hundred, who alone in Canada retained the language, and with it the traditions, of the once numerous and powerful Huron people. In the same year he was invited to attend the International Congress of Anthropology, which was convened for the World's Columbian Exposition at Chicago. To this congress he contributed a paper entitled The Fall of Hochelaga, a Study of Popular Tradition, which appeared in the volume of Memoirs of the congress, and also in the Journal of the American Folklore Society for March, 1894. In this paper he was enabled, by employing the same methods of research and analysis by which he had in early life traced out the Polynesian migrations of two millenniums, to elucidate, by the aid of traditions which had been preserved for more than four centuries among the Canadian Hurons, a singular historical mystery, which had long perplexed the writers of North American annals. When the explorer Jacques Cartier, in 1535, discovered and ascended the St. Lawrence River, he found its shores, from what is now the site of Quebec to what is now the site of Montreal, occupied by what he styled the "kingdom of Hochelaga." Its "great king and lord," from his capital at the last-named place, ruled over several communities of partly civilized Indians, who spoke a language of the Huron-Iroquois stock.

They lived in commodious bark-covered houses, cultivated extensive maize fields, and had encircled their chief town with a triple row of tree trunks, planted as palisades, and thus making it a fortress of great strength. When Champlain, nearly sixty years later, ascended the river for the purpose of founding near it a French colony, this "kingdom," with all its subject towns, had disappeared. "A few wandering Algonkins occupied, but hardly pretended to possess, the country which had been the seat of this lost empire." Its destruction has been generally ascribed to the attacks of these Algonkins. Mr. Hale's inquiries proved conclusively that this supposition was an error. The Huron traditions showed that in times long prior to Cartier's visit the Huron and Iroquois nations, speaking similar dialects, or perhaps the same dialect, had dwelt in unity near together along the St. Lawrence; that at length a rupture, of which the occasion and circumstances are minutely remembered, took place, followed by a desperate conflict; that this conflict caused at first the retreat of the Iroquois people to the region which is now northern New York; and, finally, after a long-protracted warfare, resulted in the defeat of the Hurons and their expulsion from their former seats. The Algonkins, instead of being their enemies, were their friends and allies, and still remained, when Champlain arrived, the bitter enemies of the Iroquois.

This outline of Mr. Hale's scientific work may be properly concluded by an extract from a brief sketch of his life, which appeared in the Cyclopædia of Canadian Biography: "He contributed to periodicals in the United States, Great Britain, and Canada, on scientific and literary topics, and has taken particular interest in educational matters. Through his efforts the Clinton High School and the Clinton Mechanics' Institute and Library Association were established, and he was for many years chairman of the High School Board and President of the Institute. While holding these positions he gave much time to correspondence and interviews with the Ontario authorities, and to the circulation of petitions to the Legislature, which resulted in largely increased public grants to the high schools and mechanics' institutes throughout the province, and in legislation which greatly enhanced their efficiency. One important result of the legislation thus promoted by Mr. Hale, it may be mentioned, was to secure the admission of female pupils into the high schools, on the same terms and with the same advantages which were allowed to male pupils—a privilege which had previously been denied to them. Mr. Hale has also taken part in various public enterprises, and, in especial, was chairman of the committee which secured the means for the construction of the London, Huron, and Bruce Railway—a successful work, which has added largely to the prosperity of the fertile and rapidly improving district through which it passes." Mr. Hale was an honorary or corresponding member of many learned societies, including, besides those mentioned in the foregoing sketch, the Anthropological Societies of Washington and Vienna, the Polynesian Society of Wellington, New Zealand, the Numismatic and Antiquarian Society of Philadelphia, the New England Historico-Genealogical Society, and several others.

A few days before his death Mr. Hale was notified by the Secretary of the British Association for the Advancement of Science that the Council of that body desired him to act as vice-president of the Section of Anthropology at the next meeting, at Toronto in 1897. The letter declining to accept this position, on account of failing health, was one of the last from his pen.

[Mr. Hale's first scientific publication was the first systematic contribution to the study of the Malaisian and Polynesian languages, and cast a flood of light on the subject at the outset. His last published contribution presented evidences that the native tribes of America possessed at the time of the discovery a higher degree of civilization than any one had before ascribed to them, evincing "intellectual and moral faculties of no mean order"; that they had established forms of government, a real money, "the elements of a written language, widely diffused, and employed especially in preserving, with happy effect, the memory of treaties of peace and alliance"; and a very high degree of generally diffused comfort. In preparing this paper for publication in the Journal of the Anthropological Institute of Great Britain and Ireland, for February, 1897, Mr. E. B. Tylor mentions having received, while writing, the intelligence of Mr. Hale's death with regret, but hardly with surprise, and adds: "The tone of his letters for months past had been that of a man looking toward the end of his work in life, and anxious to settle finally all matters he had much at heart. Among these were his investigations into the history of his friends the Iroquois and Hurons, to which he had given so much labor, and of which his last studies, undertaken to elucidate their native records, form a fit completion." At the conclusion of his tribute to Mr. Hale in The Critic, Dr. Franz Boas says: "His wise counsel, his amiable guidance, his kindly friendship, insure a grateful memory to him whose works students of ethnology and of linguistics will admire for all time to come. Science has lost a worker to whose enthusiasm and faithful labor we owe much; mankind has lost a man whose wisdom, kindness, and steadfastness it is hard to lack."]

Editor's Table.

THE DUKE OF ARGYLL ON EVOLUTION.

THE Duke of Argyll is a writer who finds it very hard to reconcile himself to the doctrine of evolution in the only form in which it can ever prove satisfactory to the scientific world. He believes in evolution, or, as he prefers to call it, development; but he wants to have it in a shape to suit himself, with little touches of special creation thrown in here and there, to ease off the difficult places and keep in touch with older modes of thought. He has lately returned to the subject in an article in The Nineteenth Century, some of the observations in which seem to us deserving of attention.

In the first place, we have the complaint that "the very word 'development' was captured by the Darwinian school as if it belonged to them alone, and the old familiar idea was identified with theories with which it had no connection whatever." The fact is that, if the Darwinian school captured the word development, it was not so much the result of a freebooting raid on their part as of the complete abandonment and rejection of the *idea* of development, in all that related to the origin of species, on the part of that orthodox school to which the duke gives so much sympathy. As his Lordship remarks, the facts of development had long been conspicuous in embryonic growth and in the production of plants from seeds; and yet when the idea was broached that one species might have been "developed" out of another, or that the work of creation could have proceeded otherwise than by a succession of special divine fiats, the whole orthodox world was up in arms. The "facts" of development, in spite of the "familiarity" on which the duke lays stress, had really done nothing to modify popular conception on this subject; on the contrary, opinion in the age just preceding Darwin was less enlightened by far than had been the views of many early thinkers, including that rigid doctrinarian St. Augustine. The idea of development, as applied to the origin of species, was, we may therefore say, forced upon an unwilling world by Darwin; and it is no wonder, consequently, if to some extent the idea became identified in the public mind with the Darwinian theory.

We can not agree with the duke in his criticism of the term "natural selection." The question is not how the term has been understood by careless or ignorant people, because such will always make a bungle of things, but whether it has concealed any false implications for those who have made a thoughtful use of it. The duke says that "it resorted to the old, old Lucretian expedient of personifying Nature and lending the glamour of that personification to the agency of bare mechanical necessity and to the coincidences of mere fortuity." We doubt whether, in the minds of serious thinkers, such a "glamour" ever attached to the term. On the contrary, we are persuaded that to such it suggested nothing beyond a kind of automatic movement in Nature by which the adaptation of organisms to their cosmic surroundings became ever closer and closer. His Lordship says that Darwin was led to the phrase "by an intellectual instinct which is insuperable—viz., the instinct which sees the highest explanations of Nature in the analogies of mental purpose and direction. *But*," he adds, "Darwin neither saw nor admitted its implications." If Darwin neither saw nor admitted its implications—by which the writer means its teleological implications—it was a very blind instinct indeed which led him to choose the term *because* of those implications. The fact is that Darwin had little choice in the matter. Human language is necessarily so tinctured with the idea of purpose that it is extremely difficult to find terms expressive of action which do not in some degree or other seem to imply purpose. Then we are told that "the great bulk of Darwin's admirers rejoiced in his theory for the very reason that it rested mainly on the idea of fortuity." How does this agree with the previous statement that the success of the term "natural selection" was chiefly due to the glamour it threw over men's minds as being a kind of personification of Nature? It seems as if his Lordship had not quite made up his mind as to what his views really are on this point.

We are told, not for the first time, that "it would be as rational to account for the poem of the Iliad, or for the play of Hamlet, by supposing that the words and letters were adjusted to the conceptions by some process of natural selection, as to account by the same formula for the intricate and glorious harmonies of structure with function in organic life." Statements of this kind, we must confess, seem to us rather inept. The argument is: the words of the Iliad or of Hamlet are so arranged as to render certain meanings; we know that these words were chosen by a conscious intelligent agent; wherever, therefore, we find that any arrangements in Nature are adapted to produce definite effects, we are entitled to conclude that those arrangements also had their origin in conscious and purposive effort. In other words, because results are reached in one case, or in certain cases, by purposive efforts, they must be so in all cases. Manifestly the conclusion is illicit, and yet the argument is continually being served up to us in essentially this shape. The duke talks of the "intricate and glorious harmonies" of Nature, but does he rest his argument on harmonies of this rich order? If so, where does he draw the line? How intricate and how glorious must a harmony be in order to make good its claim to a purposive origin? And may it be assumed that humbler harmonies may be the result of unconscious processes? This is no trivial logic-chopping question; it is all-important. We presume, from the duke's seeming to rest his argument on the higher harmonies, that he is prepared to abandon the lower to the reign of purely physical law; and if so, the believer in natural selection and other evolutionary formulas would like to know the extent of his conceded domain. Our impression is that, if he once gets a foot of space in the world of action and reaction, no "pent-up Utica" will long confine his powers. We may say as much of the contrary theory: once make it plain that any adaptation in Nature is distinctly purposive, and the dominion of purpose will become a universal dominion.

From our point of view, we must frankly confess, the idea of purpose is simply a drag on the interpretation of Nature. It is one of those short cuts which it does not pay to take. In so far as we assume purpose we cease to be interested in method or process. Voluntary action only comes in to do that which could not be effected by involuntary action;

and therefore if, in tracing back any chain of causation, we come to a point where we conclude that voluntary action manifests itself, we do not seek an explanation of *that*. It does not follow, however, that, because the idea of purpose is a drag on the scientific interpretation of Nature, it has no place in a rational scheme of thought. It is possible to believe, and with deep conviction, in purposes that can not be traced; and this, in our opinion, implies a more truly religious spirit than the attempt to read the petty thoughts of man into the everlasting statutes of the universe. To undertake, as the Duke of Argyll does, to indicate at what precise points in the sequence of events there must have been the introduction of a divine power does not seem to us to be religious in the best sense. At best of times we know but in part; where we know not at all let us acknowledge our ignorance, but let us not say that, because we are ignorant, we must surely be upon holier ground.

Since the above was written, a further article by the Duke of Argyll in criticism of Mr. Spencer's views has been given to the world; and, as we have our hand in, we may as well deal with it in the remaining space at our disposal. The writer declares very positively that we deceive ourselves "when we think or talk of organs being made or fitted by use," the idea being, he says, "strictly speaking nonsense," as organs are made "for use, not by use." This would be an important statement if there was only the least reason for believing it to be true, which there is not. The distinguished disputant simply assumes the conclusion which it is the purpose of his lengthy argumentation to prove. We can claim with tolerable confidence to know that organs are formed, or have been formed, by the combined action of use and natural selection, but we have absolutely no knowledge in regard to the deliberate formation of organs *for* use. We can not even begin to imagine what the nature of such a process would be.

The duke makes, however, a true and important remark when he says that "we have no antecedent knowledge of the Creator which can possibly entitle us to form any presumption as to his methods of operation." How vain, then, to say that He intervenes to form organs for use, creating them first in a very rudimentary form, and gradually improving them in the course of ages! It is because of their profound conviction that the Creator's ways are past finding out—that they can not possibly be level with the comprehension of man—that evolutionists limit themselves so strictly to the simple sequence and filiation of phenomena. When the duke says that he "can not accept, or even respect, the opinion of men who, in describing the facts of Nature, use perpetually the language of intention, and then repudiate the implications of that language when they talk what they call science of philosophy," he overlooks the fact referred to above, that as a general thing "the language of intention" is chosen because none other is available. When we say that running water sifts earthy matter, we may seem to use the language of intention, sifting being a definite action resulting in a definite, and what might look like a purposive, arrangement of the materials subjected thereto; but surely we are not required to attribute intention to the running water. It is difficult to please the duke, however; he declines to respect the opinions of those who use the language of intention without fully accepting all its implications; and, on the other hand, when Mr. Spencer seeks out the word "equilibration" to express adjustment of structure to function, he is indignant at him for *not* using the language of intention. He declares the word to be "laboriously barbarous and incompetent in its meaning," and altogether a "hideous creation." It always comes round to this in the end that the duke is entirely right and his opponents entirely wrong; and if that gratifying conclusion can not be proved, why, then it is assumed. We wonder whether the critic could not possibly make a personal application of the following judicious observation which we find in his article: "It is one of the infirmities of the human mind that, when it is thoroughly possessed by one idea, it not only sees everything in the light of that idea, but can see nothing that does not lend itself to support the dominant conception." This is precisely the duke's case: he sees nothing that does not to his mind seem to support his dominant conception; and yet, strange to say, after delivering himself of the apothegm, the only application he can make of it is to "the Darwinian school." If ever there was a case in which one might whisper, "*De te fabula narratur*," this seems to be one.

On the subject of rudimentary organs Mr. Spencer's critic indulges in much special pleading. He says we can never be sure "whether these represent organs which have degenerated or organs which are waiting to be completed." Few naturalists, we think, would agree to this. But why should any organ "wait to be completed," unless its completion is dependent on some prolonged natural process? And if a natural process can complete an organ, why might not a natural process have created its first beginnings? The duke seems to us to do here something more illegitimate than anything he charges on the Darwinian school. Confronted with the fact that organs are developed by a series of actions and reactions, of increments and adaptations, each one of which has its place in the chain of physical antecedents and consequents, he deliberately uses the expression "waiting to be completed" for the purpose of creating the impression that natural processes count for nothing, but that the "completion" depends on some kind of divine fiat. If the organs in question are in reality being completed by small improvements in adaptation from generation to generation—which, no doubt, the duke believes—is it honest to speak of them as "waiting to be completed"? We do not speak of a tree "waiting" to grow when it is growing, or of fruit "waiting" to ripen when it is ripening.

Finally, the duke says that a philosophy which is neutral "on the most fundamental of all questions respecting the interpretation of the universe"—the question, namely, "whether the physical forces are the masters or the servants of that house in which we live"—"can not properly be said to be a philosophy at all." It seems to us, on the contrary, that it is just because Mr. Spencer leaves that question unanswered, and shows that it must remain unanswered—at least in any sense that would satisfy the Duke of Argyll—that his system may claim to be a philosophy. His real answer to the question, as we conceive, would be that the physical forces are alternately servants and masters. They are servants as ministering to our mental operations and masters as determining their limits. The powers of mind are servants as being everywhere conditioned by the laws of matter, and they are masters as being alone interpretative of the universe. We are only landed in blank confusion and hopeless contradiction if we try to assign a positive and undivided supremacy to either mind or matter. No one can doubt that the Duke of Argyll is very sincere in his attachment to pre-Darwinian modes of thought; but it is no less certain that the arguments which he directs against the new philosophy have a singularly unconvincing quality. He is a writer who seems to have exhausted all his intellectual forces in convincing himself: the more carefully we read him, the more the impression grows that he has compassed sea and land, and laid a vast amount of knowledge under contribution, in a strenuous and successful effort to be on the wrong side.

A NEW SOCIAL PROBLEM.

As must have been long apparent to a critical observer of "the tendencies of the times," the department store, to which so many master minds applied themselves during the legislative season just closed, was bound, sooner or later, to rise to the dignity and importance of a new "social problem." It exhibited precisely those traits that appeal so powerfully to the shortsighted philanthropy and superficial knowledge of the "new" social reformer. It required a large concentration of capital, which has come to be regarded as *prima facie* evidence of "social peril." Because of certain economies it was able to effect, it brought about a reduction in prices, which is likewise believed by a well-known school of "uninstructed economists" to be a deplorable evil. Finally, it tended to crowd to the wall smaller concerns dealing in the same class of goods, that found themselves unable to compete with it.

Here were all the elements that go to make up a first-class "social problem." A vivid imagination, inflamed by a deep sympathy with immediate inconvenience and suffering, drew a harrowing picture of the distress to individuals and to society. In the first place, there were the small shopkeepers, high-spirited and independent, driven out of business and compelled to become "mere clerks" under the roof of their merciless rival. In the second place, there were the empty stores scattered all over a city that had been occupied to the advantage of their owners. In the third place, there were the loss of general knowledge of any given business, the confinement of the poor clerks to some special department, and their reduction to the humiliating and paralyzing position of "only cogs in a great piece of commercial machinery." Is it any wonder that such a spectacle moved the hearts of the philanthropists and statesmen in the Legislatures of Missouri, Minnesota, Illinois, and New York? Was it not as plain as a pikestaff that something was wrong? Was it not "the duty of society" to remedy it? Who could be so ignorant and callous as to insist that these questions were absurd—that they applied to the spinning jenny and the power loom as well as to the department store?

Yet such is the fact. The department store is as much a labor-saving device as a steam engine or the telegraph and telephone. One as much as the other is a product of industrial evolution. Like the mediæval fair or the modern market, the department store is a segregation of commodities and of buyers and sellers. Like the perfecting press also, which unites in one machine several distinct processes, such as inking, printing, cutting, and folding, it is an integration under one management of a number of forms of trade carried on under different managements. It enables capital to gain such generous rewards that it can command executive talents of a far higher order than those content with the profits of a small concern. As a consequence, its management is the most efficient—that is to say, the most economical. Obeying still further the law of evolution, the several departments also fall into the most efficient hands. The subordinates are likewise intrusted with the particular duties they are best fitted for. Thus, from top to bottom, there is an adaptation of means to ends far beyond the reach of an establishment where the management is of a low order of ability and the subordinates unite in their duties a variety of functions. A further gain is had from saving in rents, and from the purchase of goods in large quantities. Besides economy in prices, so important to the multitude of consumers, whose welfare the "new" social reformer seldom considers, there is economy in time and effort. The department store enables them to obtain what they want with a minimum of movement.

In absolute ignorance of the nature and achievements of the immutable law that has called the department store into existence, the "new" social reformer has begun to wrestle, as already stated, with the "problem" it presents. He has begun to repeat the follies that every inventor from Arkwright down has had to face. To be sure, no department store has been sacked or burned; but the legislation proposed as a "remedy" has virtually the same object in view, namely, the destruction of an important labor-saving device. But, most happily, it presents difficulties to its enemies that a mere machine does not offer. Not long ago, when a number of them met in Chicago to propose a solution of the "problem," they could not, as might have been foreseen, agree upon the limit to put upon the kinds of goods the department store should sell. Hardly had the druggist vented his grievance and suggested the rigid exclusion of his goods before the tobacconist arose to protest against the incursion of the druggist into his domain. The grocer filed a like complaint against the butcher, who sells vegetables as well as meat. It was discovered also that the butcher trespassed upon the fishmonger and the oyster dealer. In selling beer and liquor, the grocer was guilty of a similar offense against the saloon keeper. Equally culpable was the tobacconist who sold papers and umbrellas; the shoe dealer who sold trunks and valises; the bookseller who dealt in candy and stationery; and the milliner who sold corsets and toilet articles. In fact, the meeting contained hardly a protestant that did not deal in one or more articles outside of his specialty, and thus present the same "serious problem" that the department store does. Naturally, it broke up without having reached a decision as to how the "problem" should be solved.

Although the same insuperable difficulties confront the "new" social reformer and are not unlikely to prevent him from getting the legislation so generally regarded as the solvent of most troubles, the "problem" of the department store is not insoluble. That is to say, a limit upon its scope is not impossible nor improbable. But the limit will not be drawn by the "wise legislator," but by the law of evolution itself. There is reason to believe that the small store, devoted to special lines of goods, will not succumb altogether. Of certain staple goods and of all goods of a medium or inferior quality, the department store will doubtless retain the monopoly.

But in the highest class of certain goods, such as furs, linens, tailor-made gowns and suits, diamonds and jewelry, porcelain and furniture, the small dealer may be expected to control the retail trade. He alone will possess the high degree of special knowledge and be able to give the personal attention that his business requires. He alone will find it worth his while to cater to the few but wealthy customers that want the best to be had. The department store will find it more profitable, as indeed it does now, to cater to the larger class of customers that care more for cheapness than great excellence. Because of this fact, it is already noticeable, particularly in the inland cities, that specialists have begun to establish themselves, usually taking modest apartments in some large commercial building. Thus, in spite of the department store and without the aid of the "new" social reformer, there will be preserved to the world this class of people with all their "manhood" and "independence," thought to be so important to civilization.

Scientific Literature.

SPECIAL BOOKS.

Among the many manuals of architecture Mr. Mathews's book* takes a distinct place. It is a concise history of architectural development through all the various phases of civilization, showing the important modifications produced by location and national life.

Beginning with the time when man longed for something more than mere shelter and strove to make his habitation pleasing to the eye, the author traces the art of construction as it was unfolded in Egypt and Nubia, India and Java, China and Japan. Then, crossing to the Western hemisphere, which is never reached by some writers, he gives an outline of its evolution among the Toltecs, Aztecs, and Incas. Returning to the Old World, he takes up the record of the ruins in western Asia, Chaldea, Assyria, and Persia. Thence the transition is easily made to Greece, Etruria, and Rome; for, although there is an early period of classical architecture—the Pelasgic, whose Cyclopean masonry and corbeled vaulting betray no foreign influence—the efflorescence of Greek art took place many centuries after the Dorian invasion and subsequent to the Persian conquest, when the Greeks had come into contact with many nations and had assimilated whatever was of worth. They borrowed the fluted pillar and molded lintel from the tombs of the Egyptians, but they increased the proportional height of the column until it formed the stately Doric. The colorettes of Nineveh and the Persian capitals possibly suggested the Ionic order; the Greek architect, however, gave it graceful proportion. So, with all the ideas that may be traced to outside sources, the beauty of the transforming touch is clearly recognized, and it is readily acknowledged that for nobility of purpose and an exquisite sense of harmony the architecture of Athens is still unrivaled. "The artist bowed himself to his task with all the unselfishness attendant on an act of worship. To look at Nature, see only the best, and make it immortal . . . may be justly called the mainspring of all Hellenic thought, taste, and feeling."

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* The Story of Architecture. By Charles Thompson Mathews, M. A. New York: D. Appleton & Co. Pp. 468. Price, $3.

Rome was indebted to Etruria and Greece for the elements of her architecture. From the former the arch, vault, and Tuscan order were derived, while the latter contributed the Doric, Ionic, and Corinthian orders. In amphitheaters, aqueducts, and baths she easily surpassed other nations, while in the basilica or law court she furnished a design for Gothic cathedrals and the churches of the Renaissance. Classical ideas prevailed over all countries under Roman rule until the division of the empire. Subsequently the Byzantine style was evolved in the time of Constantine, who spent immense sums in beautifying Byzantium and Constantinople. To this we owe "one of the finest constructive inventions," the pendentive system.

Early Christian architecture was exemplified in the basilicas, which were built in the form of a Latin cross; the introduction of the apse and a great increase of interior decoration were also marked features of the style. This was followed by the round-arched Gothic or Romanesque.

Meanwhile with the Moorish dominion came the Saracenic style, which may be studied in the mosques and tombs of the East and in the palaces of Spain. Although contributing no new principle, "the world owes it a debt of gratitude for its ornamental exuberance controlled by good taste." Interiors were made exquisite with fretwork, mosaics, and jeweled inlays, while minarets and domes of graceful proportions were beautified with tiles "belonging to a lost ceramic art."

Gothic architecture is considered by Mr. Mathews in its two developments, ecclesiastical and secular, the different periods and characteristics being very carefully and clearly explained.

Two chapters are devoted to the Renaissance, which the author has treated in more detail in another volume, and the book concludes with an examination of American architecture. The high buildings of the present day are relegated to the province of engineering; most of them are "attenuated monstrosities." However, "when a whole block is devoted to such a structure, and the design is treated pyramidally, the result may be stately and imposing."

The work is amply illustrated, and a bibliography, index, and glossary add much to its convenience and value.

In his recent work on economics Prof. *H. J. Davenport* makes large use of the suggestive mode of imparting knowledge.* He asks suggestive questions at the beginning of each chapter, review questions at the end, and topical questions in the margins. In preparing the book he has evidently had college students in mind for whom the instructor would be available to supplement the text with lectures and answers to questions. The vigorous thinker might dispense with such aid, but the average learner is very often left by suggestive teaching encumbered with many hazy ideas and exasperated with many unanswered queries. Our author generally avoids short and precise definitions. He seeks to give an understanding of the nature of utility, wealth, value, capital, etc., by leading the reader to look at each from different points of view and thus to build up in his mind a composite picture, as it were, of the thing or quality. In discussing wages and profits he represents these two terms as essentially identical and makes compensation for risk a separate thing. They are paid with the residue of production after the service of land and capital are requited. The wage-earner's assurance, he says, of receiving the approximate value of his product rests solely upon the effectiveness of competition among employers. His wage is, however, guaranteed from falling very low by his own power of producing directly for the market. This in turn is limited by his lack of capital. Prof. Davenport accounts for international trade like exchanges between individuals on the theory that each party finds he can satisfy his desires at less sacrifice by making one kind of goods and exchanging the surplus for the surplus of the different kind of goods produced by the other party. In measuring the "sacrifice" or cost, however, other than material things often have weight. The latter portion of the work is devoted to practical economic questions of the day. Here he discusses the competitive system and the remedy which is claimed to lie in socialism. He sees a promising field of usefulness for trades unions in establishing emergency workshops between which exchanges could take place by barter. Other topics that receive attention are State ownership of transportation and other industries, the social function of the rich, race improvement, the economic influence of fashion, taxation, various labor topics, and the currency. His general method of treating these matters is to point out the conflicting considerations that bear upon them, but without assuming to declare which outweighs the other. If the work resembled many others, in presenting one view of each topic as the only correct one, it would be much easier to describe, but we can not say that it would be as useful to its readers.

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* Outlines of Economic Theory. By Herbert Joseph Davenport. New York: The Macmillan Co. Pp. 381, 8vo. Price, $2.

While fully appreciating the value of Froebel's kindergarten work, Mr. *Hughes* wishes teachers to realize that Froebel laid down principles of the greatest worth in more advanced education.* He has accordingly, in this volume, set forth the philosophy of Froebel's system, giving a chapter to each of its most prominent features. Comparing Froebel with Pestalozzi and Herbart, Mr. Hughes says: "Pestalozzi was instinctive and inspirational, Froebel was philosophical and investigative. . . . Pestalozzi's pupils were reproductive; Froebel's were creative. . . . Herbart studied the child to mold it; Froebel studied it to guide it in its growth. . . . Herbart saw the need of control much more clearly than the need of freedom; Froebel saw the harmony between freedom and control." Froebel's fundamental law, according to our author, is that of unity or inner connection. "He saw the unity between knowing, feeling, and willing, between analysis and synthesis, between thought and life. He saw the unity or inner connection of all created things so clearly, that he made the reconciliation of opposites an important element of his system. He believed this law of unity, inner connection, or vital interrelationship to be universal, and made it the fundamental law and the ultimate aim of all true educational effort." The most fruitful of Froebel's principles was that of self-activity on the part of the child—"the spontaneous effort of the child to make manifest to itself and others the inner conceptions and operations of its own mind." This is very different from action initiated by the teacher. While he insisted that the child's individuality should be respected, he did not advocate giving the child license to do wrong. The teacher should be able to transfer the child's interest from what is wrong to what is right. He wished to banish coercion; he "would have the control of the mother and kindergarten so thoroughly in harmony with the spontaneity of the child as not to be felt by it." He fully recognized the educational value of play, and was the first to use it systematically as a means of mental and moral training. His profound sense of interrelationships made him a pioneer in the correlation of studies. The same characteristic caused him to look beyond mere perception on the part of the learner, and to insist on apperception. Froebel was an evolutionist before Spencer and Darwin, and he was the first to make systematic use of manual training in distinction from industrial training. The supreme aim of his educational system is character-building, and "he applied precisely the same laws to the revelation of ideals of right, justice, duty, and will that he applied in the general development of the child." In stating Froebel's views Mr. Hughes makes large use of quotations from Froebel's Education of Man and Autobiography, and from the Baroness von Marenholz-Bülow's Reminiscences of Froebel. The book is eminently one to stimulate the teacher's growth.

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* Froebel's Education Laws for All Teachers. By James L. Hughes. International Education Series, Vol. XLI. New York: D. Appleton & Co. Pp. 296, 12mo. Price, $1.50.

GENERAL NOTICES.

In *Telepathy and the Subliminal Self* we have an attempt to put certain occult phenomena on a scientific basis.* The author, rejecting all ideas of the supernatural, approaches his subject from the point of view of a scientific observer who does not speculate with the intangible, but who has a definite theory, that shall account for certain mysterious occurrences. The subjects he takes up are Telepathy, Mesmerism and Hypnotism, Clairvoyance, Double or Multiplex Personality, Somnambulism, Dreams, Automatism, Planchette, Crystal-gazing, and Phantasms. He explains most of these phenomena by means of the subliminal self. This mysterious personality lies hidden away deep down below our ordinary self, coming to the surface only on special occasions, or when called up without our knowledge by the hypnotizer or mesmerist. And it does not seem to be given to every one thus to project this inner being into the outer world of sense; although apparently this other personality is latent in us all, only the "sensitive" can manifest it. The author deduces his theory from a number of experiments and "experiences" recorded by the English Society for Psychical Research, the French therapeutic hypnotists of La Salpêtière, and of Nancy, and others, both physicians and laymen. The chapters on Double or Multiplex Personality and Natural Somnambulism give a number of cases in which the subliminal self stands plainly revealed. Some instances, however, might very well be classed under temporary aberration of mind, as for example that of Ansel Bourne the evangelist, who, leaving his home in Rhode Island, went to Norristown, Pa., and after keeping store there for two months under the name of A. J. Brown, suddenly awoke to find himself in a strange place. One of the most curious chapters in the book is that on Crystal-gazing, a species of divination somewhat akin to clairvoyance. The chapters on Phantasms sustain perhaps most fully the author's theory of the subliminal self. He does not pretend to go over the whole ground of psychic phenomena, leaving untouched, for example, the subject of the return of the departed, and other spiritualistic manifestations. But "confining ourselves within the limits assigned, if the series of alleged facts which has been presented in the preceding chapters be true, then we are in the presence of a momentous reality which, for importance and value, has not been exceeded, if indeed it has been approached, by any of the discoveries of modern times." However far the author's theories and enthusiasms may carry him, the book is an honest effort to explain some more or less tangible occurrences in a rationalistic manner, free from superstitious cant. It is a readable and interesting contribution to the literature of the new psychology.

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* Telepathy and the Subliminal Self. An Account of Recent Investigations regarding Hypnotism, Automatism, Dreams, Phantasms, and Related Phenomena. By R. Osgood Mason, A. M., M. D. New York: Henry Holt and Company. Pp. 343, 12mo. Price, $1.50.

Two out of the forty-five volumes of the *Library of the World's Best Literature* * have come to hand. This work, unique in scope and character, aims to do for literature what the Encyclopædia Britannica has done for the arts and sciences in general—to give a survey of what the best poets, writers, and thinkers of all ages have thought and felt and expressed in artistic form, from the records indelibly stamped on the baked brick of the Assyrians, the characters traced on the papyrus of the Egyptians and Chinese, the pergamena of the Greeks and Romans, the vellum of the mediæval monks, even down to the type-written manuscript of the present day. The plan, in the words of the editor in chief, Mr. Charles Dudley Warner, "is simple and yet it is novel. In its distinctive features it differs from any compilation that has yet been made. Its main purpose is to present to American households a mass of good reading. But it goes much beyond this; for in selecting this reading it draws upon all literatures of all times and of every race, and thus becomes a conspectus of the thought and intellectual evolution of man from the beginning. Another and scarcely less important purpose is the interpretation of this literature in essays by scholars and authors competent to speak with authority." Many of the best critics, both in this country and abroad, have taken part in the making of the work. Among the American contributors of note to the first two volumes may be named Prof. Toy, of Harvard, who writes on Accadian, Babylonian, and Assyrian Literature; Mr. H. W. Mabie, on Addison; Dr. H. T. Peck, on Æsop and Alciphron; Mr. R. Burton, on Amiel; Prof. E. S. Holden, on Arago; Rabbi Gottheil, on the Arabian Nights and Arabic Literature; and Prof. Woodberry, on Matthew Arnold. The selections thus introduced by critical and biographical essays, and representing the author at his best, are carefully chosen with reference not only to their literary quality, but also to their interest as reading matter, for "the work aims to suit a great variety of tastes, and thus to commend itself as a household companion for any mood and any hour." The names are arranged alphabetically, for ready reference. The volumes are handsomely bound in half morocco, with clear print on good paper, and illustrated with portraits of the authors, colored plates, and photogravures.

Prof. *Baldwin's* book on *School Management* is devoted to the practical side fo the subject.* It takes up the several divisions of educational work systematically, and gives helpful advice and suggestions on a vast number of topics in each division. Pupil improvement is the keynote of the work, and the author aims to show how this can be secured through better educational conditions and facilities, better school and college organization and correlation, and the most efficient methods of teaching, and how school government and class management can be made educative. Among the elements of educative governing power he names, first, character. "Be what you wish your pupils to become," he says. Next he places culture, and charges the teacher to "cherish the spirit of mastery and broad culture." Other elements whose importance he explains are pupil insight, teaching power, heart power, will power, system, tact, and bearing. Of the possible incentives to school work he points out which are low motives, which higher, and which the best. He shows how school regulations can have an educative effect, and what punishments operate to help and what to harm the pupil. In other chapters he gives advice as to school hygiene, means and methods of administration, methods of teaching the usual school studies, ways of conducting partly graded schools, etc. He is a strong advocate of oral teaching, by which he means something like the Socratic method, with the use of objects for some studies. Prof. Baldwin's teachings are everywhere positive and emphatic, and he ignores any possible difference of opinion on such subjects as corporal punishment, free text-books, and coeducation. The book is intended to be used for systematic study by classes of teachers, and each chapter is accordingly divided into sections and subdivided into paragraphs, each with a number and a heading. There is also a syllabus to each chapter, and a list of topical questions at the end of the volume.

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* A Library of the World's Best Literature, Ancient and Modern. In 45 volumes. New York: The International Society. Price, cloth, $3 a volume; half morocco, $4 a volume.

* School Management and School Methods. By Joseph Baldwin. International Education Series, Vol. XL. New York: D. Appleton & Co. Pp. 395, 12mo. Price, $1.50.

Prof. *Wiley* has brought to a close his carefully prepared treatise on *Agricultural Analysis* with a volume devoted to agricultural products.* The first chapter relates to methods of preparing samples by grinding, drying, incineration, and extraction. Twenty-six forms of apparatus for these operations are here figured. The first group of substances for which processes of analysis are given consists of the sugars and starches. The specific gravity, the polariscopic, and the reduction methods for sugar analysis are each represented by a number of processes. The author has not undertaken to select the best practice for dealing with every problem, as he has not been writing solely for students, but more for trained analysts who are competent to select for themselves from several carefully described modes. A variety of miscellaneous processes for sugar analysis are also described. The determination of starch requires less space, and from this the author passes to methods for separating and determining sugar, starch, and other carbohydrates in crude or manufactured agricultural products. The fats and oils form the next large group of substances treated, and considerable attention is given to their physical properties, as well as to their chemical behavior. Methods of estimating nitrogenous bodies follow; dairy products have a section by themselves, and a considerable number of substances are grouped as miscellaneous. These include cereals, fodders, meats, fruits, vegetables, tannins, tobacco, tea, coffee, and fermented beverages. In dealing with meats several methods of artificial digestion and of determining nutritive values are described. The volume is indexed, and is illustrated with one hundred and twenty-five figures of apparatus. A list of authorities cited is given at the end of each division of the work.

In his *Laboratory Practice for Beginners in Botany*, Prof. *William A. Setchell* has furnished a guide for the application of the laboratory method to the study of plants (Macmillan, 90 cents). He takes up the seed first, because "it is not only readily obtained, readily studied, and its meaning clear, but it is also one of the most convenient starting points for a study of the life history." His first directions will indicate his method. "Take the ripened pod of a bean plant and, splitting it open, notice: 1. That the seeds (beans) are attached along one edge of each valve (or half) of the pod. 2. That each bean is attached to the pod by a short stalk, the *funiculus*. 3. Make a sketch of a valve of the bean pod with its inclosed beans, representing and labeling the parts." Drawing is a constant requirement throughout the course. In the advanced lessons questions are asked which it is not practicable to answer otherwise than from consulting books. There is a brief appendix of suggestions to students and one more extended of suggestions to teachers, in which reading for each chapter is specified and various directions as to material and details of instruction are given. Although the author says that his book is intended for the higher grades of primary schools or for secondary schools, he has apparently made no effort to keep his language within the vocabulary understood by children, hence we doubt that the book would be available below the secondary grade. There are no illustrations.

Robert the Bruce and the Struggle for Scottish Independence, by Sir *Herbert Maxwell*, Bart. (New York: G. P. Putnam's Sons, 1897, $1.50), is one of the scholarly volumes of the Heroes of the Nations Series. It deals with the making of Scotland. The first five chapters give a short survey of the country up to the year 1305, a period of internal discords, and feuds with England because of the latter's claim to the overlordship. The greater portion of the book recounts the deeds of Robert the Bruce, the national hero. His coronation as King of Scots, in 1306, marked an epoch in Scottish history. Become king of a country that was claimed by the English Edward, and surrounded by only a small band of faithful followers, Bruce virtually had to conquer his realm foot by foot, until the decisive battle of Bannockburn, in 1314, forced the English to acknowledge his sovereignty. The many exciting adventures of the landless king, and his daring and personal bravery, are well set forth in some of the most interesting chapters of the book.

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* Principles and Practice of Agricultural Analysis. Vol. III. By Harvey W. Wiley. Easton, Pa.: Chemical Publishing Company. Pp. 666, 8vo. Price, $3.75; complete work, $9.50.

Among the papers submitted in competition for the Hodgkins Fund prizes and published by the Smithsonian Institution is one on *Atmospheric Actinometry*, by *E. Duclaux*. The chemical radiations of the sun do not behave within our atmosphere in the same way as the heat and light rays. This is indicated by the differing effects on the photographer's plate on days equally luminous, and by the rapid progress of vegetation in high latitudes as compared with temperate regions. The investigations which M. Duclaux describes are based upon determinations of the oxidation of solutions of oxalic acid exposed to the sunshine under a wide variety of conditions.

In the introduction to *The Story of the Birds*, by *James Newton Baskett*, M. A., Associate Member of the American Ornithological Union (New York: D. Appleton and Company, 1897, 65 cents), one of Appletons' Home-Reading Books, the editor of the series, Dr. W. T. Harris, points out the two movements of the new education—original observation and verifying by experiment on the part of the pupil, and systematic home reading to supplement class-room instruction. "A library of home reading should contain books that stimulate to self-activity and arouse the spirit of inquiry. The books should treat of methods of discovery and evolution. All Nature is unified by the discovery of the law of evolution." In keeping with the aims here set forth, The Story of the Birds gives a brief account of the evolution of the bird, as far as such can be traced by means of the present characteristics of the feathered race. Beginning with the bird's fore leg, popularly known as the wing, which is an important factor in determining its past history, the author goes on to the discussion of the bird's raiment, its outer wraps and its underwear, its "frills and furbelows." We have chapters devoted to the wooing and mating of birds, to nest-building and nesting habits, to birds' eggs and the rearing of the young. Various habits of grown-up birds are touched upon, their expedients in getting a living, their tools and tasks, the way they go to bed, and their manner of travel. In the last two chapters hints are given for recognizing and classifying the different species. Scientifically accurate, yet free from technicalities forbidding to the uninitiated, the book, written in a pleasing style, recommends itself not only to the young student, but also to the general reader who, as a lover of birds, wants more than a passing acquaintance with them. It is profusely illustrated. An analysis of the chapters, with study hints, and an index, add to its usefulness.

In a pamphlet entitled *A New Dairy Industry* a process for preparing sterilized milk for infants is described by *James Fred. Sarg* (the author, Kempsville, Va., 80 cents). Mr. Sarg writes for the farmer, who, he says, is best situated for preparing a suitable infants' milk and should have the profit of the industry. Whether discoursing of the operation of milking, the mortality of infants, or the details and apparatus of the process that he describes, Mr. Sarg writes with vigor and an evident mastery of his subject. His pamphlet is illustrated with figures of machines and other appliances.

An inaugural discourse before the Royal Academy of Sciences of Havana, on the study of spectroscopy (*Introducción al Estudio de la Espectroscopia*), by Dr. Gastón Alonso Cuadrado, of the medical corps of the Spanish army, presents a clear and carefully elaborate summary of the theory and properties of light as illustrated by the latest discoveries, including a brief account of the Röntgen rays.

Rules for Regulating Nomenclature in Entomological Work, compiled by *Lord Walsingham* and *John Hartley Durrant*, of Merton Hall, Thetford, England, and published by Longmans & Co. (20 cents), have been prepared with a view to securing a strict application of the law of priority. One of the objects of the authors has been to define a method by which the recognition of antecedent work can be consistently secured. They propose that this rule be designated as "Merton rules" for convenience of reference.

Convinced that physical science awaits its next greatest elucidations from the side of biology, Dr. *Ernst Mach* has made from time to time various researches on sensation, the results of which he states in a volume under the title *Contributions to the Analysis of the Sensations* (Open Court Publishing Company, $1.25). He here discusses the space sensations of the eye in connection with the innervation of that organ and the physiological aspects of sensations of time and sensations of tone. The conclusions which he has arrived at on these topics show, he affirms, that "there is no rift between the psychical and the physical, no *within* and *without*, no *sensation* to which an outward, different *thing* corresponds. There is but *one kind of elements*, out of which this supposititious within and without is formed."

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Fragments of Science.

Dr. Ebenezer Emmons and the Olenellus.—During the geological survey of the State of New York which, commenced in 1836, was almost the first of the geological surveys that were entered upon and properly prosecuted in the United States, there was a marked difference of opinion between Prof. Ebenezer Emmons, of Williams College, who had charge of the portion of the survey that embraced the rocks of western Massachusetts and the upper waters of the Hudson, and his associate geologists, which finally terminated in a bitter personal antagonism and almost social ostracism of Dr. Emmons. The point at issue was mainly the relationship in respect to position and age of the rocks in question, especially those typified by the strata of Greylock Mountain and the Hoosic Valley. The position taken by the majority of the associate geologists on the survey was that the so-called Silurian system of rocks constituted the basis of the fossiliferous rocks of New York and inferentially of the whole country, and that the so-called "Potsdam sandstone" was the lowest fossiliferous member of this system, and in fact marked the dawn of life upon the planet. Dr. Emmons, on the contrary, claimed that beneath the oldest member of the Silurian system there was an older and extensively developed system of fossiliferous rocks, to which he gave the name "Taconic," and exhibited an entirely new and characteristic fossil not before recognized or described, and which received the name of "Olenellus." For all this Dr. Emmons received little or no credit, and among geologists was regarded as visionary and something of a humbug. But time has at last brought its revenges, for, at the last meeting of the British Association for the Advancement of Science (Liverpool, September, 1896), Mr. J. E. Marr, F. R. S., President of the Geological Section, in an address reviewing the recent progress in this department of science, took occasion to speak of the "Olenellus"—whose first discovery he attributed to Dr. Emmons—as characterizing a zone of life in rocks much older than the Silurian system, and as "furnishing us with a datum line from which we can work backward," and possibly prove the existence "of a fauna of a date anterior to the formation of the Olenellus beds." So that Dr. Emmons, in place of being wrong in his observations and deductions in 1845, did really find the fossil he described, and rightly located the rock containing it in the geological horizon; and thus was entitled to take the lead at that time over all his American and European colleagues.

Koch's Latest Tuberculin.—Since the premature announcement of Dr. Koch's consumption cure, some six years ago, the doctor has been steadily at work endeavoring to perfect his method, and it is now announced that he has succeeded in eliminating those irritating substances which were so troublesome in the early preparations. From his observations Koch concluded that the affected patient gradually acquired a degree of immunity through the absorption of certain constituents of the bacilli themselves. This immunizing, however, usually occurs too late in the disease to save the patient. In order to collect these substances, whatever they may be, he dries and triturates the dead bodies of the bacilli, and from the resultant powder makes two extracts. The first of these is opalescent, and is practically identical with his original serum. He calls it tuberculin O (TO). The remaining sediment is again dried, digested with water, and then centrifuged, and this is continued until the water is perfectly clear. These later extracts contain the essential immunizing principle which he calls tuberculin R (TR), and with which such encouraging results are said to have been obtained.

Some Notes on a Dust Storm.—Apropos of our recent article on Dust Storms, we have received the following item from Mr. W. S. Jackman: "On the 19th of February, 1896 (*Ash Wednesday*, by eternal fitness), a remarkable dust storm descended upon the city of Chicago. As the ground had been completely covered with snow to the depth of several inches a day or two previous, it was an easy matter to form some estimate of the quantity of dust that fell. The storm began in the evening and lasted several hours. The next morning, by selecting suitable open areas that were likely to be free from eddies and local currents, an average per square yard of 1·34 ounces of dust was obtained. This was gathered by scraping up the snow to the depth the dust had penetrated—about one inch—and, after melting it, the water was evaporated and the dust dried. The amount thus collected measured 2·45 cubic inches. At this rate the quantity of dust deposited upon a square mile would be about 129·6 tons; the volume would be on the same area 4,352 cubic feet, equal to a pile about thirty-four feet long, sixteen feet wide, and eight feet deep. On being strongly heated in a clay crucible the dust turned reddish brown and lost twelve per cent of its weight. The microscope showed it to be largely composed of irregular and rounded quartz grains. As the storm began after dark, people who were unfortunate enough to be caught in it were at a loss for a time to know just what was the matter. In many instances nothing unusual was suspected until, entering their homes, their smeared and blackened countenances called forth an unwontedly hilarious greeting. After the snow melted, in many instances the sidewalks were so covered with the slimy mud as to need scraping and washing. The storm seemed to come from the northwest, and was accompanied by a moderate gale."

The Law of Mississippi Floods.—An important point in Mr. James L. Greenleaf's study in the Engineering Magazine of the Times and Causes of Western Floods is the topographical division of the country drained by the Mississippi into several large water sheds, covering a total area of 1,259,000 square miles. Although this topographical division has been wrought by natural causes, the consideration of the water sheds must be combined with that of climatic areas for the purposes of the present study. All the rivers tributary to the Mississippi show a decided tendency to low water in the autumn, the southern waters beginning to fall from a high stage in June and the northern in July. All begin to rise from low water in winter—the southern tributaries earlier, and the northern ones later. Two freshets occur during the year in each of the large tributary basins. The coincidence of the highest stage in more than two of the large branches is extremely rare, and hence it is an exception for the main river to be subjected to the enormously congested state which would otherwise result. The varying stages of the Mississippi accurately reflect the fluctuations of rainfall and of temperature which occur upon its tributary basins, and these are followed in detail in the author's paper. The Mississippi being virtually created by the union near one point of three large rivers—the Ohio, the Missouri, and the upper Mississippi—these three branches, of which the Ohio is regarded as the most important, naturally stamp their characteristics upon it to a very marked degree, and it bears these features through the entire course to the Gulf. The large tributaries farther south modify but can not control their overwhelming influence. The two periods of flood characteristic of each of these large tributaries have an important bearing upon the continuance of high water in the main river, pouring their floods in one after the other as the force of the preceding flood is beginning to be spent, so that the tendency is for the main river to flow in strong volume until well into the summer. The river is a result; its tributaries are the cause. Viewed broadly, a general similarity of behavior is observed; yet each feeder of the main river has its special cycle of alternations between high and low water; each great line of drainage has its special feature of flow. Were the secondary watercourses followed, the vast Mississippi water shed would be seen covered by countless brooks and rivulets, each affected by local conditions, yet all obeying a few fundamental laws, "which gather the waters as in the hollow of the hand and pour them through a single channel to the sea."

The Turbinia.—In a recent issue of Industries and Iron is a detailed description of the Turbinia, the vessel which recently attained the highest velocity ever reached by a steam vessel, an average of 32¾ knots on the measured mile. As her name suggests, she is fitted with steam turbines instead of the ordinary form of engine. The Turbinia was built by a syndicate formed especially for the purpose of testing the application of the compound steam turbine to marine propulsion. She is 100 feet in length, 9 feet beam, and 44½ tons displacement. The original turbine fitted in her was designed to develop upward of 1,500 actual horse power at a speed of 2,500 revolutions per minute. The boiler is of the water-tube type, for 225 pounds per square inch working pressure. The hull is built of steel plates, varying in thickness from $\frac{1}{16}$ to $\frac{3}{16}$ of an inch. A curious difficulty was encountered in the early trials. It was noticed that a great deal of power was being lost somewhere, and it finally turned out that, owing to the high speed of the propeller, what is known as cavitation was produced—that is, the screw tended to scoop out a hole in the water and run in this, thus using up a part of the energy simply in maintaining this cavity. This difficulty has been, to some extent, overcome by altering the pitch of the blades, but it is believed that further experimentation will result in overcoming this fault more completely, and hence make a still higher rate of speed possible.

German Colonies for Unemployed Workmen.—The first of the German Arbeiter Kolonie, or refuges for workmen out of employment, one of which has been described in the Atlantic Monthly by Mr. Josiah Flynt, was established by Pastor von Bodelschwingh at Bielefeld, Westphalia, about 1882. There are now twenty-seven such colonies in Germany, where men able and willing to work may go, and at least pay their way till some more profitable labor is found. Connected with them is an estate near Berlin, where men who have proved deserving may acquire a piece of land and eventually set up homes of their own. Applicants for help must promise to stay in the colony at least four weeks, and have the privilege of staying longer if no work has been found for them outside; while the managers are on the lookout for work for them, in order that they may go and other out-of-works may take their place. The colonies are supported by contributions and the proceeds of the work of the colonists. Mr. Flynt applied at the Berlin colony at Tegel, and, on complying with the conditions required, was assigned to a section and set to making straw cases for wine bottles. He was expected to work to the best of his ability and to show respect to the officials—a Hausvater and a foreman, the only outsiders connected with the institution. The day was spent according to a prescribed routine, beginning at five o'clock in the morning and ending at nine o'clock at night, while Sunday was given to church and rest. Every man received a mark, or twenty-five cents, a day, and some, working by the piece or at special work, made a mark and a half. Out of these earnings, eighteen cents a day were taken for food and lodging. Several men had credit in the colony treasury. The food was simple but abundant, and the beds were fairly comfortable. A store was opened on Saturday afternoons, where the colonists could buy tobacco and various useful little things. Newcomers were confidentially exhorted and admonished on Sunday afternoons by the pastor. Forty-nine men were in the colony during Mr. Flynt's stay. In winter there are more than three hundred. The colonies are believed to be useful in distinguishing the deserving unemployed from the undeserving, and helpful to the former.

Diffusion of an Ancient Symbol.—The *swastika*—a design resembling two Z's, normal or reversed, so arranged as to cross one another—is described and studied as "the earliest known symbol" in a paper by Thomas Wilson in the Proceedings of the United States National Museum. It appears in various shapes, derived from the original, and is the parent of various scroll forms and ornaments. Its origin and original bearing or application are lost in the darkness of remote antiquity. It denotes something good, and is an ornament. It is found in the far East and the classical East, in all the cities of Troy, in Egypt, Algeria, and Ashantee, in the ancient Grecian countries, in western Europe from the bronze age down, on ancient coins, in prehistoric America, and among the North American Indians. Allied to it are meanders, ogees, and spirals; and associated with it are various prehistoric objects in both hemispheres. In America, the swastika of the mound builders, or of the oldest civilization we know here, is similar in every respect, except material, to that of the still living Navajo and Pueblo Indians. The two curious facts are emphasized that the swastika had an existence in America prior to any historic knowledge we have of communication between the two hemispheres; and that it is continued in America, and used at the present day, while the knowledge of it has long since died out in Europe. Mr. Wilson's chief study is to find how this symbol was carried from one region to another. While the theory that like features of life originate naturally at like stages in the development of different peoples, and the one that they are carried by migrating hordes, may both be true to a certain extent, neither should be insisted upon as exclusive. Mr. Wilson maintains that the swastika was carried, as some other customs may have been, by teaching, or by the transmission of the idea from one country to another—much in the same way as Greek art and architecture have come down to us—rather than by independent invention or by migration of peoples.

Richard Hakluyt.—The Hakluyt Society has recently celebrated in London the fiftieth anniversary of its work in publishing volumes, usually containing the texts of travelers and voyagers in all parts of the world, which were previously not known to the public. It is named, Sir Clements Markham says, after Richard Hakluyt, who was born in 1553, acquired a love of geography from an uncle of the same name, and assiduously sought and read every narrative of adventure he could procure, mastering six foreign languages in order to be able to do so. He strove to remedy the ignorance of seamen of the scientific branch of their profession, and to supply the absence of records for want of which important voyages and travels were allowed to fall into oblivion, with a measure of success that has given him rank among the benefactors of their country. He was irrepressible in seeking new information. He rode two hundred miles to have an interview with the last survivor of Master Hose's Expedition to America in 1536. He saved numerous journals and narratives from destruction, and the deeds they record from oblivion. His work gave a stimulus to colonial and narrative enterprise, and inspired literature. Shakespeare owed much to Principal Navigators, his chief book. As the years passed on, he, according to his own quaint language, continued "to wade still further and further in the sweat studie of the historie of cosmographie," and achieved his great task, which was "to incorporate into one body the torn and scattered limbs of our ancient and late navigations by sea." He declared "geography and chronology to be the sun and moon, the right eye and the left, of all history." When he died, November 23, 1616, he was Archdeacon of Westminster, and had reached his sixty-fourth year.

Primitive Traveling.—Of the motives and lengths of the journeys of primitive man Mr. O. T. Mason observes, in his monograph on Primitive Travel and Transportation, that birds of passage made formerly longer journeys than men, and the length of their migrations in time and distance was equaled, perhaps, by those of fishes and marine animals. The simple motives that governed these movements were the same as constituted the incentive to human movements over the earth. The coming and going of birds and marine creatures are likewise the occasion of an enormous amount of human bustle and running about. Most of the domestication of animals is prompted by a desire to have them at our doors, and to make us independent of their migrations. Land animals, as well as birds and sea animals, were often obliged by natural conditions to travel great distances, and men followed them in order to live upon them. In every tribe there are stories of travelers who made long voyages and returned. Dr. Boas says that the myths of the northwest coast of America point across the Pacific. Besides the traditions that fix upon the present habitat as the primal home, there is a class of migration myths. The perfection of devices also prolongs travel. The East Greenlanders journey around to West Greenland to get snuff, and will consume four years in a single excursion there and back, often, according to Nansen, remaining no longer than an hour at the trading station before taking up their homeward march. The Manchus and Manyarg, who navigate the Sungari River, spend from eight days to a month, according to the destination, in their journeys; the Turki, near East Cape, from four to six months. According to Seton Karr, the tribes of northwest British Columbia were afraid to quit their tribal territory, but now Indians are willing to accompany the white man through regions that are as strange and unknown to them as to him. The extent and direction of aboriginal journeys have been in some places cut off, and in others greatly stimulated, by contact with the Caucasian race.

Utilization of Wind Power.—A summary of the conclusions reached by M. Maximilian Plessuer from a study of the economies of wind as a source of power is given by M. Henry de Varigny in a paper on Air and Life, published by the Smithsonian Institution. The irregularity of the wind forms the chief objection to placing reliance upon it, but much depends upon localities. There are places and large regions where it is fairly regular. It seldom fails at the seashore, and the trade winds are nearly constant; while in most parts of the globe it becomes more regular as the altitude increases. Hence, upon the whole, a considerable part of the world is well suited for investigations upon the best methods of deriving power from the winds. The first requisites of a wind-power machine are some sort of a motor driven by the wind, and an accumulator to store the energy and yield it at the required moment. Dismissing the old windmill and the æolian wheel as not fully coming up to the mark, M. Plessuer turns to sails as affording a possible solution of the problem. "The utilization of the power of the winds," he writes, "and its transformation into mechanical work are only possible by means of sailing vehicles, driven by wind upon a circular railway, the power generated by such rotation being transmitted to an axle and thence to machinery." On this railway a circular train, made of small cars coupled together, each carrying a mast and two sails at right angles with each other, is driven by the wind. The sails are automatically trimmed, and automatically also they expand or contract, or rather take in the wind or withdraw from it. As long as the wind blows the train continues rotating, and if it is connected with a central axle the latter may work dynamos and charge electrical accumulators. A similar apparatus might be arranged in water, boats taking the place of the cars, and, since the wind power is transformed into electricity, the latter may be stored and kept in reserve, or transferred to a distance to perform ten, twenty, or fifty miles away any work that may be required.

"Our Friends the Monkeys."—Why, asks M. Paul Mégnin in La Nature, should we not call monkeys our friends? They have been calumniated and had all sorts of evil qualities attributed to them, because when we make pets of them we encourage and cultivate their odd traits, and spoil them as children are spoiled. All monkeys have not equal degrees of intelligence, but most of them are capable of a development equal to if not above that possible to any other animals. They love to learn, and the imitative instinct natural to them permits them to execute all sorts of feats with agility. They learn tricks more readily than dogs, and, although not manifesting so hearty good will toward the public, execute them with marvelous agility and grace. At Hagenbeck's establishment in Hamburg, where two hundred monkeys enjoy complete liberty of play in the great rotunda, they are given multitudes of children's toys, balls, hoops, wheelbarrows, joiner's benches, etc., and learn to manage them all without any one showing them how. In the center of the rotunda is an immense grain hopper, from which the seeds, corn, walnuts, chestnuts, apple quarters, etc., run into a trough when a wheel at the top is turned. The management of this hopper did not have to be explained to our friends the monkeys. While one of them turns the wheel, the others, sitting around the trough, enjoy the delicacies as they come down, till the one at the wheel, thinking his turn has come, stops, gives the signal for some one to take his place, and comes down to get his share. What other animals are capable of so intelligent an initiative?

Minute Earthquakes.—Very delicate experiments have been instituted by Prof. John Milne to determine the stress inflicted upon the earth's crust by small, even minute, disturbances, whether local earthquakes on a small scale, faint echoes of more violent distant disturbances, those arising from meteorological causes—which are receiving special attention—or even those which are due to the falling of rain and to dew. A shower of rain or a deposit of dew represents a considerable load on the soil, which may perhaps be regarded, in the first instance, as uniformly distributed, but which will probably, because of inequalities in evaporation, not remain so long. The ground on the east side of a building will be more quickly dried than that on the north; the dew on the east side will evaporate before that on the west side, and so on. Thus there will be bending stresses in the soil tending to tilt buildings or piers for instruments that have not deep-laid foundations. Tilts due to rainfall would be irregular; those arising from dew would show a diurnal period. The inquiry is made whether these tilts are large enough to affect astronomical observations. Diurnal oscillations of several sections of an arc have been detected by seismographs in Japan, which Prof. Milne attributes to the evaporation of dew. At the observatory of the University of Oxford a disposable weight, consisting of a crowd of human beings, was utilized. Formed into a solid square, they were marched back and forth, to and from the observatory wall. They were then spread out so that they only touched by the finger tips; and again so as to cover four times the space of that formation. This was supposed to represent the evaporation effect. Seventy-six persons were thus employed, and their marching back and forth produced an appreciable bending of the earth. As an aid to his research, Prof. Milne has had a horizontal pendulum set up in the Isle of Wight, in order to obtain a continuous automatic record of such disturbances as are there manifested.

Improvement in Antitoxine-Making.—In a recent number of the *Archives des Sciences Biologiques* issued by the Imperial Institute of Experimental Medicine at St. Petersburg is an important announcement by Dr. Smirnow, describing a new method of obtaining diphtheria antitoxine. Hitherto the preparation of the antitoxine has not only involved great expense, but also much time, several months oftentimes. The new method announced by Dr. Smirnow institutes a great saving in both time and expense, and consists simply of electrolyzing a virulent diphtheria broth culture, which is then found to contain an antitoxine of great power and efficacy. Dr. Smirnow states that a dog weighing from eighteen to twenty pounds, inoculated subcutaneously with 0·5 cubic centimetre of a virulent diphtheria broth culture, usually dies in two or two and a half days. If, however, even one day after inoculation, treatment with the new serum is begun, from three to five cubic centimetres of the latter suffice to save the animal.

Maxims for the Holiday.—The first requisite to the complete enjoyment of a holiday, as laid down by the London Lancet, is to have earned it. Only a true workman thoroughly enjoys his season of rest, while the idler, the trifler, the man of pleasure, knows little of its delights, for it brings him no change. It is well, in arranging for the holiday, to give attention to individual tastes and idiosyncrasies, so that the lover of natural scenery, the seeker for historical associations, and the lover of art may each go where he will find what he will enjoy the most. For the best use of a holiday some definite object may be combined with the general fundamental idea of rest; but there is a possibility of carrying this feature too far and making the excursion a season of work. This leads to the next rule, not to attempt too much. "Take it easy," should always be the motto. Long railway journeys and tedious excursions drawing upon the strength are good things to avoid. Age, physical condition, and previous training should always be regarded; change of life and surroundings should be sought, but mischief may result if the change is too violent; and whatever interferes with regularity of life and sleep should be indulged in only sparingly. Provided the traveler is a good sailor, few forms of holiday are so entirely unobjectionable as a sea voyage.

MINOR PARAGRAPHS.

According to Curator Duerden, of the Museum of the Jamaica Institute, as cited by Robert T. Hill in Science, a turn of the tide has come in the life of the mongoose in Jamaica. This animal was imported there to rid the island of rats. Having disposed of these, it turned upon the other small animals and nearly exterminated them. Consequently the ticks and chigoes, in the absence of the lizards and snakes which had eaten them, throve enormously, and became nearly as veritable pests as the rats had been. Within the past few years, however, the mongooses have seemed to decline in numbers, and, when caught, to be suffering from the attacks of ticks. Birds and snakes and lizards are becoming more numerous, poultry and domestic animals suffer less from depredations, numerous crocodile's eggs are found, bevies of quails are occasionally seen, and the rats are appearing again.

The researches of Alfred Goldsborough Mayer on the color and color-patterns of moths and butterflies have resulted in the demonstration of several results believed to be new to science, among which are the prevalence of a surprisingly large percentage of black in the great majority of the colors of *Lepidoptera*, the composite character of the colors as distinguished from simple colors, and the derivation of the pigments of the scales by various chemical processes from the blood, or hæmolymph, of the pupa. While the number of species of *Papilio* in South America is nine times as great as in North America, the number of colors which they display is only twice as great. Hence the greater number of colors displayed by the tropical forms may be due simply to the far greater number of species, and not to any direct influence of climate. The scales in *Lepidoptera* do not strengthen the wing or aid the insects in flight. The vast majority of the scales are merely color-bearing organs which have been developed under the influence of natural selection.

According to a communication of M. Albert Gauttard to the French Ethnographic Society, the efforts which the Japanese have been making since the revolution of 1868 to adapt themselves to European civilization and modes of life have resulted in surprising transformations of their national type. Some of them are losing the eccentricity of their eyes and the prominence of their cheek bones; children born recently have less flattened noses than their ancestors, and a skin not so yellow. On the other hand, Europeans residing permanently in Japan lose the rosy color of their skin and tend to acquire an eccentricity in the eye. M. Adhemar Leclère, French resident at Kratié, said that he had observed that some of the French residing in Cambodia began in a short time to acquire the type and the gait of the natives.

In the use of the Iroquois wampum belts, his studies of which have already been noticed in the Monthly, the facts associated, and other features in the Indian life of both American continents, Mr. Horatio Hale believed that evidence was found that the Indians enjoyed systems of government and forms of civilization that evinced intellectual and moral faculties of no mean order—a real money, elements of a written language widely diffused and employed in preserving the memory of treaties of peace and alliance, established institutions working well, and a good degree of generally diffused comfort.

NOTES.

The summer courses of the Massachusetts Institute of Technology, beginning at different dates in June and generally continuing through July, are intended for the benefit of students who wish to prolong their stay in summer or to make up deficiencies, and are open to persons not students in the institute if they possess the necessary qualifications. The subjects are in the departments of mechanical drawing and descriptive geometry, mathematics, architecture, chemistry, biology, physics, European history, French and German, mechanism, and shop work; and provision is made for other (non-technical) subjects for those interested in them.

The International Exposition to be held at Brussels this year will include an International Section of Sciences, divided into the seven Sections of Mathematics and Astronomy, Physics, Chemistry, Geology and Geography, Biology, Anthropology, and Bibliography. Various privileges will be granted to participants, who will have to pay nothing for their places, and will be allowed rebates on railroads. A series of questions have been prepared by the Belgian Government, on which prizes will be awarded for the best solutions. The prizes appertaining to the Section of Sciences are valued at four thousand dollars. Programmes contain full information on this subject by addressing the Commissariat General of the Government, 17 rue de la Purse, Brussels.

The Division of Entomology of the United States Department of Agriculture is engaged in a special investigation of the insects that infest stored crops. The list includes the insect enemies of stored grain, flour and meal, fruits, nuts and seeds, herbs and dried plants, drugs, leather, specimens of natural history, etc. Information is invited from citizens who have made observations in the matter, particularly from persons residing in the South. Special attention is directed to the use of bisulphide of carbon, applied as a vapor to pervade the stored material.

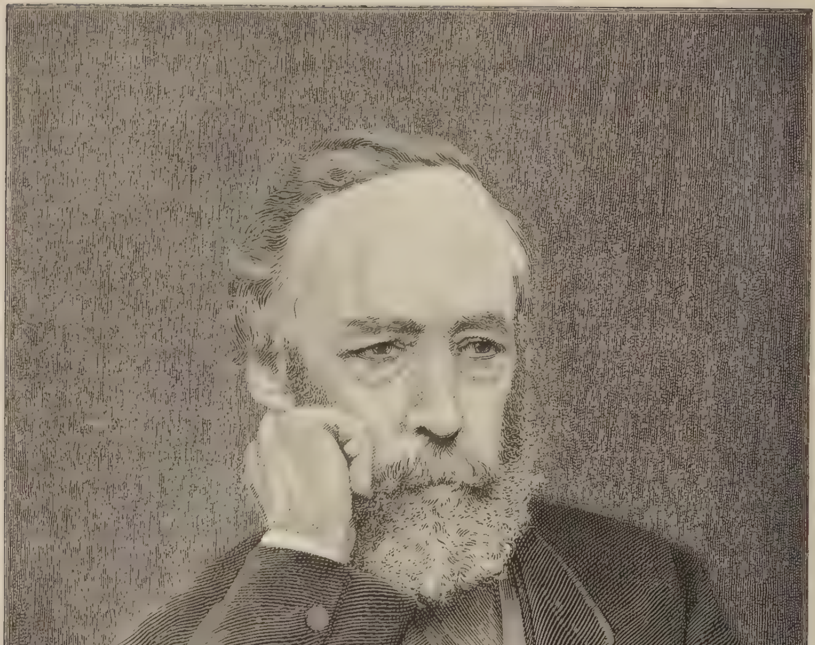
Granite, wood, and asphalt being accepted as the best materials for carriage-way pavements in large cities, preference between them should be, Mr. L. H. Isaacs, C. E., says, in the order, on the score of public hygiene: asphalt absolutely, granite, wood; of noiselessness, wood, asphalt, granite; of safety to horses, wood, asphalt, granite; of cleaning, asphalt, wood, granite; of economy, granite, wood, asphalt; of facility in repairing, asphalt, wood, granite; and of convenience in connection with tramway rails, granite, wood, asphalt.

Alvan H. Clark, the famous maker of telescopic lenses, died of apoplexy at his home in Cambridge, Mass., June 9th. He succeeded his father, Alvan Clark, whose fame as a lens maker was equally world-wide, as head of the firm on the death of the latter in 1887. Of his make were the twenty-six-inch lens in the Naval Observatory at Washington, and the thirty-inch refractor for the Imperial Observatory at St. Petersburg, for which he was decorated by the Czar; the great lens of the Lick Observatory; and the lens for the Yerkes Observatory, Chicago, forty inches in diameter, and having a focal length of sixty-four feet, which was completed and shipped only a short time before his death. As an astronomer he accompanied the total-eclipse expedition to Jerez, Spain, in 1870, and the similar expedition to Wyoming in 1878; and discovered fourteen double stars, including the companion to Sirius—for which he received the Leland gold medal from the French Academy of Sciences.

Dr. Traill Green, Emeritus Professor of Chemistry in Lafayette College, died at Easton, Pa., April 29th, aged eighty-four years. He became a professor in Lafayette College sixty years ago; was dean of its scientific department and founder of its astronomical observatory; was one of the original members of the American Association; was first President of the American Academy of Medicine; and was author of a work on the Floral and Zoölogical Distribution of the United States.

Mr. J. Theodore Bent, explorer, classicist, and archæologist, died in London, May 5th, of malarial fever contracted in a journey in Sokotra and southern Arabia—from which he had just returned with Mrs. Bent—followed by pneumonia. He had spent the winters of several years in journeys of research, the fruits of which he recorded in valuable and interesting books. Among the subjects that engaged his attention were the archæology, classic survivals, and customs of Greece; the Bahrein Islands of the Persian Gulf; the Arabian states; Abyssinia; and Mashonaland, where he was the first to make a systematic exploration of the ruins of Zimbabwe. His papers before the Royal Geographical Society, the British Association, etc., were of high merit, and his collections had unique value.

The Duc d'Aumale, who died from the effects of the shock occasioned by the terrible disaster at the Charity Bazaar in Paris, was a member of the French Academy, and was distinguished throughout the scientific world for his gift to the Institute of France, in trust for the nation, in 1884, of the Château of Chantilly for a museum, with the forest and estates for its maintenance.



JAMES CROLL.

APPLETONS'
POPULAR SCIENCE
MONTHLY.

AUGUST, 1897.

THE RACIAL GEOGRAPHY OF EUROPE.

A SOCIOLOGICAL STUDY.

(*Lowell Institute Lectures, 1896.*)

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VI.—FRANCE. PART II.

WHY is Belgium entitled to a separate national existence among the states of modern Europe? Ireland and even Wales have tenfold stronger claims to political independence on the score both of race and religion. One half of this little state is topographically like Holland; the other is not to be distinguished in climate, geography, or soil from Alsace-Lorraine—that shuttlecock among nations. Belgium is father to no national speech. The Flemings can not hold common converse with their fellow-countrymen, the Wallons; for the first speak a corrupted Dutch, the second an archaic French language. Nor are the people more highly individualized in the anthropological sense. In fact, in a study of races Belgium is not to be considered apart from either northern France or southwestern Germany. It is closely allied to both. Of course, even despite the lack of all these elements of nationality, there is still a reason for the separate political existence of the Belgians. There must have been, for the sense of nationality is very intense among them. There is no sign of its abatement at the present time. It has made them a dominant power in Africa and elsewhere abroad. Their nationality is a geographical as well as an historical product. We shall deal with that presently. In the meantime we must consider the Belgians together with the whole population of northern

France. It is befitting to do so; for Cæsar informs us that the Belgæ in his time controlled the whole region. Roman Gaul, properly speaking, extended only as far north as the Seine and the Marne. In Cæsar's time the frontier of Belgium—the land of the Belgæ—lay near Paris. Has its recession to the north produced any appreciable change upon the people? Certainly not in any physical sense, as we shall attempt to point out.

The northern third of France and half of Belgium are to-day more Teutonic than the south of Germany. This is clearly attested by the maps which show the distribution of each of the physical characteristics of race. It should not occasion surprise when we remember the incessant downpour of Teutonic tribes during the whole historic period. It was a constant procession, of Goths—from all points of the compass—of Franks, Burgundians, and others. France was entirely overrun by the Franks, with the exception of Brittany, by the middle of the sixth century. All through the middle ages this part of Europe was not only ethnically Teutonic: it was German in language and customs as well. The very name of the country is Teutonic. It has the same origin as Franconia in southern Germany. In 812 the Council of Tours, away down south, ordained that every bishop should preach both in the Romance and the Teutonic languages. The Franks preserved their German speech four hundred years after the conquest.* Charlemagne was a German; his courtiers were all Germans; he lived and governed from outside the limits of modern France. The Abbé Sieyès uttered an ethnological truism when, in the course of the French Revolution, he cried out against the French aristocracy: "Let us send them back to their German marshes whence they came!" Even to-day the current of migration between France and Germany sets strongly to the south, as it has ever done in virtue of economic laws deeper than national prejudice or hostile legislation.†

The movement of population racially has been strongly influenced by the geography of the country. Were it not for the peculiar conformation of this part of Europe, there would be no geographical excuse for the existence of Belgium as a separate political entity, as we have said; and northern France would be far more thoroughly Teutonized than it is to-day. In order to make this clear, we must recall the topography of the district for a moment. From the Alps in western Switzerland a spur of mountainous country of very indifferent fertility, known as the Ardennes plateau, extends far out to the northwest, its axis lying along the Franco-German frontier, as our map of the geography of France shows. This area is triangular in shape, with its apex

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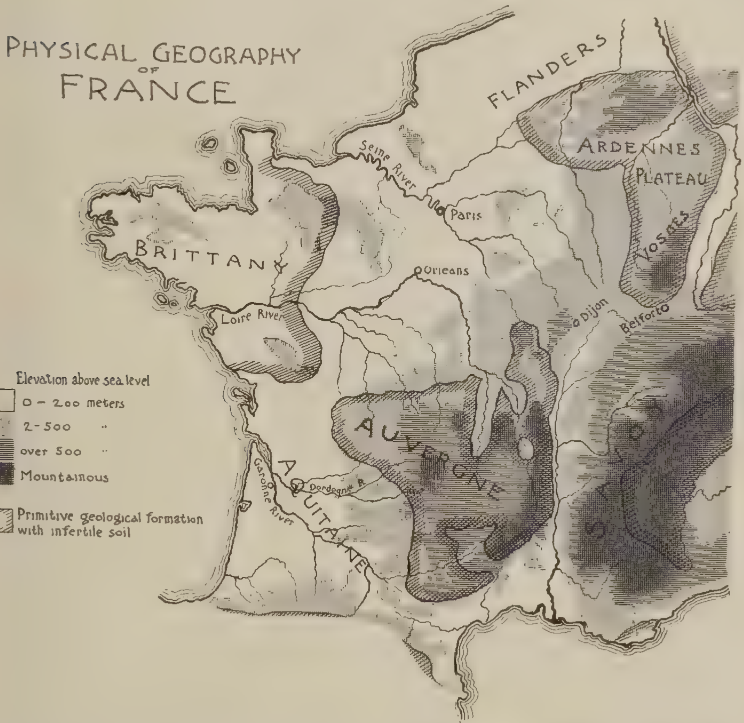
* For many details, and a map of German place names in northern France, consult that remarkable book of Canon Isaac Taylor, Names and Places, pp. 94 *seq.* It is a work which should be made familiar to every would-be teacher of history and geography.

† The standard authorities upon Belgium are E. Houzé, Ethnogénie de la Belgique, Bruxelles, 1882; and L. Vanderkindere, L'Ethnologie de la Belgique, Bruxelles, 1879. R. Böckh, in Zeits. f. allg. Erdkunde, Berlin, iii, 1854, p. 80, has mapped the linguistic boundary. *Cf.* also H. Vandenhoven, La Langue Flamande, Bruxelles, 1844. The last investigation is by K. Brämer, in Kirchhoff's Forschungen zur deut. Land- u. Volkskunde, ii, 1887, Heft 2. The boundary of the Flemish language on the south in France is mapped by R. Andrée in Globus, xxxvi, 1879, pp. 6–10 and 25–29. *Vide* also G. Lagneau, Ethnogénie des Populations du Nord de la France, Rev. d'Anth., 1874, pp. 577–612.



touching Switzerland, the Rhine forming its eastern edge, and its base lying east and west across Belgium a little north of Brussels. This base is the geographical boundary between Flanders and the rugged uplands. Near the southern point, this Ardennes plateau rises into the Vosges Mountains. The major part of it consists of an elevated table-land, of little use in agriculture. Its uplands are heavily forested; its valleys are deep and very narrow. This plateau is divided from the main body of the Alps by a low pass about twenty-five miles wide, known as the Gap of Belfort. This has always formed the main pathway of communication between the valleys of the Seine, the Rhone, and the Rhine, from the time of Attila to that of the Emperor William I. It is the strategic key to central Europe. The only other routes from France to Germany cut straight across the difficult Ardennes plateau, following either the valleys of the Meuse or the Moselle shown on our map. These valleys are both extremely fertile, but narrow and easy of defense. Sedan commands the one and Metz the other. This depression at Belfort has played quite a unique part in the natural history of Europe as well as in its military campaigns. It is the only route by which southern flora and fauna could penetrate to the north, since they could not traverse the Alpine highlands. The parallel is continued by the constant counter-migration of southern culture over the same way, evinced in archæology and history. It is not surprising that in anthropology this Gap of Belfort should be equally important.*

This Ardennes plateau is the core of a considerable population, which is primarily of the Alpine racial type. It is an anthropological table-land of broad-headedness, surrounded on every side except the south, where it touches the Alps, by more dolichocephalic populations. Turn for a moment to our map on page 440. Notice the wing of dark tint extending up to Luxemburg from Belfort. Observe how it is eroded on the east along the Rhine Valley, and toward Paris in the fertile plains of the Isle de France. In the recesses of the Vosges Mountains the cephalic index rises 87; in the valleys of the Meuse and the Moselle it falls to 83.† The Germanic tribes in their ceaseless wanderings are the cause of that phenomenon beyond question. It is evident that for Teutonism to enter France, it must pass through the Gap of Belfort, around north through Flanders, or follow the valleys above mentioned. All three of these it has certainly done in the anthropological sense. It has overflowed along each of these channels, traversing the Alpine racial barrier. It has done even more. Its influence is manifest even in the nooks and byways. For the people of the whole region are well above the average French in stature. They are quite Teutonic in this respect. But the invaders have not been able to efface that most persistent trait of the primitive population—the broad, round head. Here, as in the Black Forest, just across the Rhine, this physical characteristic remains as a witness of priority of title to the land.

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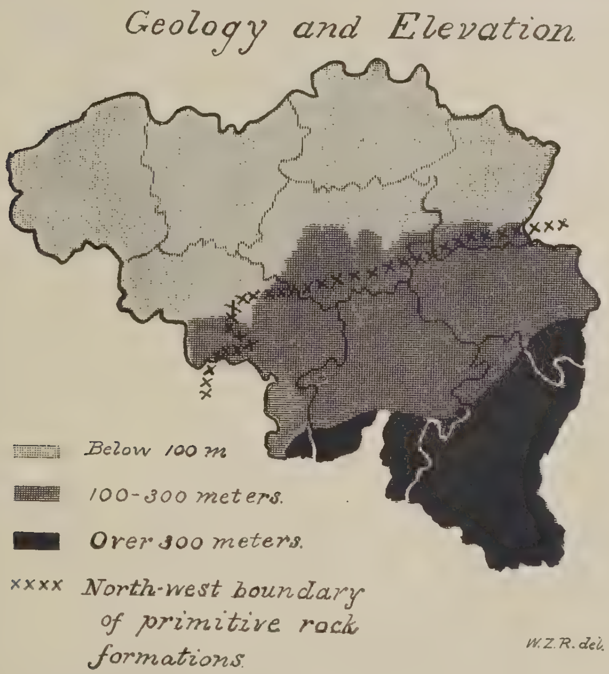
* W. Marshall, Tierverbreitung, in Kirchoff's Anleitung zur deut. Landes- u. Volksforschung, p. 256. Montelius, Verbindungen zwischen Skandinavien und dem oestlichen Europa, Archiv für Anth., 1891, pp. 1–21.

† The authority upon this region is Dr. R. Collignon. *Vide* his Anthropologie de la Lorraine, Nancy, 1886; especially, the map opposite page 9, showing the influence of the river valleys: L'Anthropologie, I, 1890, p. 211 *seq.*; and Bull. Soc. d'Anth., Paris, 1887, p. 306; ibid., 1883, p. 463. Auerbach gives a fine description of the geographical features in Revue de Geographie, Paris, 1890–'91.

In Belgium itself, lying on the northwestern edge of the Ardennes plateau, the contrast between the upland and the plain is so distinct, and it coincides so closely with the racial boundary between the Flemings and the Walloons, that it merits special attention. Language here follows closely in the footsteps of race. As our three maps of the country show in detail, the Walloons in the uplands are broader-headed than the Flemings. They are distinctly shorter in stature.* Our map shows how much more infrequent blond types are among them than among the Flemings. It is curious to notice this Teutonism of Flanders and the Low Countries. It denotes the utter extermination of all traces of the Spaniards, despite their whilom political activities. Belgium is sharply divided, therefore, into two halves, following the topographical boundary of the plateau exactly, except in the department of Hainault, where Walloons are found in the plains. The two halves of Belgium thus indicated differ in poli-



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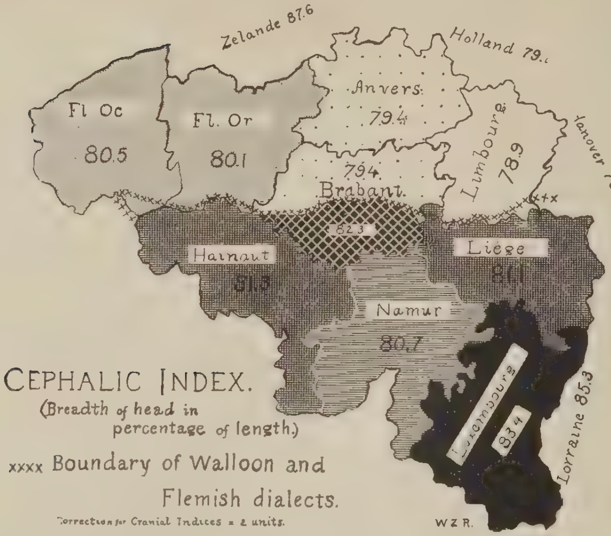
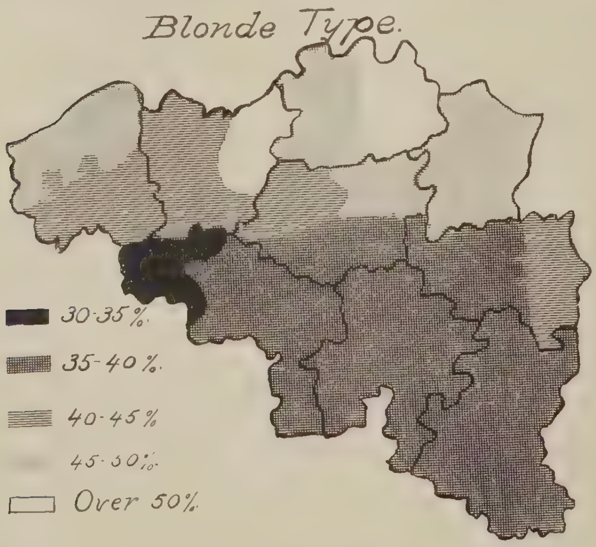
* Quetelet long ago showed this. *Vide* Titeca, Bull. Soc. d'Anthropologie de Bruxelles, vi, 1887, p. 109. Houzé has mapped the stature in ibid., vi, 1887, p. 278.



tics, language, and in many social customs. One, Flanders, is cultivated largely by tenant farmers, the other tilled by peasant

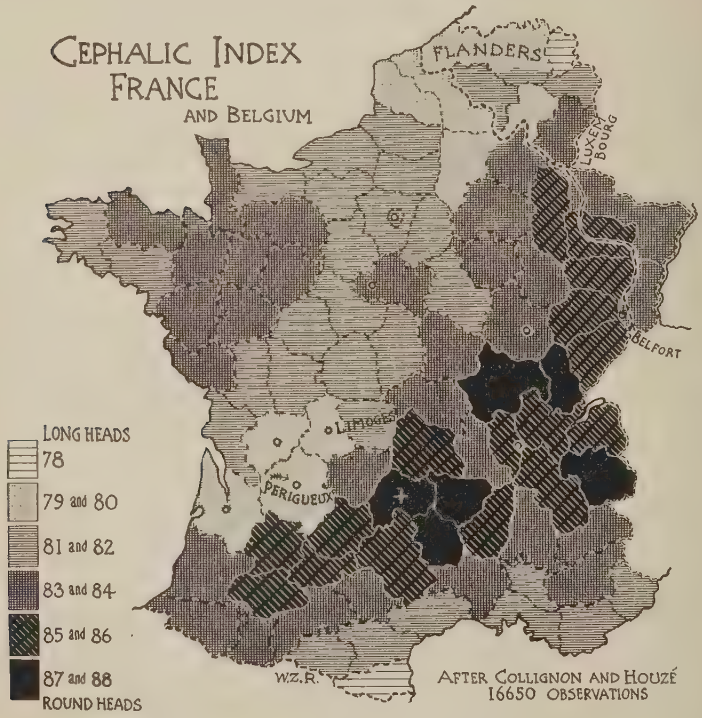


proprietors. So clearly drawn is the line of division that many interesting sociological problems may best be investigated here. These, for the moment, we pass by. For us, at this time, the significance of the division is, to put it in Dr. Beddoe's words, that "the Walloons and their hilly, wooded country are a Belgic cliff against which the tide of advancing Germanism has beaten with small effect, while it has swept with comparatively little resistance over the lowlands of Flanders and Alsace, and penetrated into Normandy and Lorraine." Had it not been for this geographical area of isolation, political boundaries would have been very different from those of to-day. Belgium is a piece of pie-shaped stop-gap between France and Germany. Being internationally neutralized in the military sense, it covers the main line of contact between the two powerful neighbors—the plains of Flanders. This is, in the eyes of the natural scientist, its main excuse for separate existence as a political entity. The Franco-German hatred is nothing but a family quarrel after all from our point of view. It is a reality, nevertheless, for historians. The only country whose population is really homogeneous is the tiny kingdom of Luxemburg in the very center of the plateau, scarcely more than a dot on the map. It deserves its independence for a like reason with Belgium. Were Alsace-Lorraine also a neutralized and separate kingdom, the prices of European government bonds would be considerably higher than they are to-day.

Let us now return to France again. We have still to cover the most interesting part of all in many ways. Cæsar's third division of Gaul, from the Loire River southwest to the Pyrenees, was inhabited, as he tells us, by the Aquitani. Strabo adds that these people were akin to the Iberians of Spain, both in customs and race. Detailed study, however, reveals a population far less homogeneous than these statements of the ancients imply.

A glance at the map of the physical geography of France, on page 435, shows that this southwestern section is centered in the broad, fertile valley of the Garonne. From Bordeaux in every direction spreads one of the most productive regions in France, favored alike in soil and in climate. Ascending the river valley, it narrows gradually until we reach a low pass, leading over toward the Mediterranean. This little axis of fertility, along which will run the projected canal to unite the two seacoasts of France, divides the plateaux of Auvergne from the highlands which lie along the Pyrenees. In this latter region fertility decreases as we approach the Spanish frontier in proportion to the increase in altitude, although most of the region is fairly capable of supporting a considerable population. The only extensive area which is extremely unfavorable in character is the seacoast department of Landes, along the Bay of Biscay south of Bordeaux. This region is a vast sandy plain, but little raised above the sea level. It is a flat district underlaid by an impermeable clay subsoil, which is, except in midsummer, a great fen covered with rank marsh grasses. Without artificial drainage, it is unfit for cultivation, so that it remains to-day one of the most sparsely populated sections of the country. As a whole, then, the southwest of France presents the extremes of economic attractiveness, at the same time being devoid of those geographical barriers which elsewhere have strongly influenced the movements of races.

The first impression conveyed by the general map of the cephalic index for all France, in respect of this particular region above described, is that here at last all correspondence between the nature of the country and the character of the population ceases. A wedge of the broad-headed Alpine stock centering in the uplands of Auvergne pushes its way toward the southwest to the base of the Pyrenees. This Alpine offshoot extends uninterruptedly from the sterile plateau of Auvergne, straight across the fertile plains of the Garonne and deep into the swamps and fens of Landes. While the geographical trend of the country is from southeast to northwest parallel to the Garonne, the population seems to be striped at right angles to it—namely, in the direction



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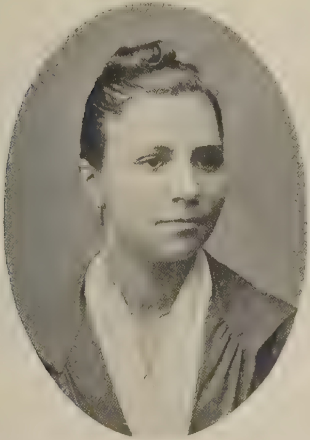
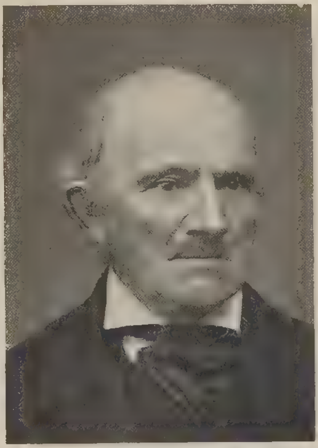
of the Paris-Bordeaux axis of fertility. At the northwest appears the lower edge of the broad-headedness of the area of Brittany; then succeeds a belt of long heads from Paris to Bordeaux, to the south of which comes the main feature—a central strip of the Alpine type pushing its way to the extreme southwest, as we have said. The portrait herewith is a good example of the last-named round-headed type, which forms the bulk of the population. We are confronted by a racial distribution which appears to be utterly at variance with all the laws which elsewhere in France determine the ethnic character of its population.



MEDITERRANEAN TYPE. Montpellier.
Cephalic Index, 79·6.



ALPINE TYPE. Aveyron.
Cephalic Index, 86.

One point is certain: either conditions have changed wonderfully since Strabo's time, or else the old geographer was far from being a discriminating anthropologist, when he described the people of Aquitaine as uniformly Iberians, both in race and in customs. A large element among them is as far removed from the Spaniards in race as it is possible in Europe to be. There is, as our map shows, a strip all along the Mediterranean which is Iberically narrow-headed and oval-faced, of a type illustrated in our portrait. Especially is this true in the department of Pyrénées-Orientales, shown on our map by the banded white area. This is the only part of France where the Catalan language is spoken to-day, as we took occasion to point out in our first article. This population in Roussillon is truly Iberian both in race and language; all the other peoples of Aquitaine differ from the Spaniards in both respects.*

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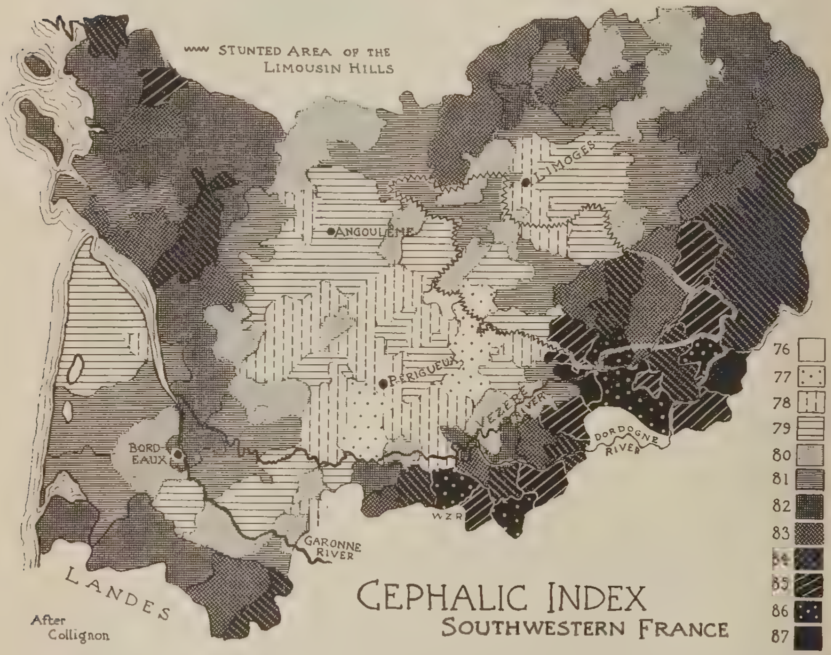
* The prime authority upon this part of France is again Dr. Collignon. *Vide* Mém. Soc. d'Anth., Paris, series 3, i, fasc. 3 and 4. Condensed statement of his views is given in

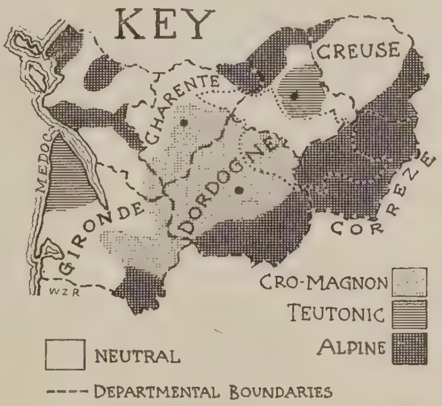
Turn back for a moment to the map of head form on page 440, and notice the curious light-tinted area in the heart of this south western region. It seems to be confined to four departments, lying between Limoges on the northeast and Bordeaux at the southwest. This little island or sink, if you please, of long-headedness has for years been a puzzle to anthropologists. It is a veritable outcrop of dolichocephaly close to the great body of broad-headedness which centers in Auvergne. It lies, to be sure, at the southwestern extremity of that axis of fertility from Paris to Bordeaux which we described in our last paper. In conformity with the law of differentiation of populations which holds all through the north, a long-headed people is found in the plains. The trouble is that the people are altogether too extreme. The general law is out-proved by it. The remoteness of this spot from any other great center of long-headedness constitutes the main point of interest. Such a trait ought to have been derived either from the north or the south of Europe. Teutonic intermixture is not a competent explanation for two reasons. In the first place,



CEPHALIC INDEX
SOUTHWESTERN FRANCE

Annales de Géographie, Paris, 1896, pp. 156–166. Our maps are adapted from this latter source. G. Lagneau, Ethnogénie des Populations du Sud-ouest de la France, in Revue d'Anth., 1872, pp. 606–628, gives much interesting historical material.

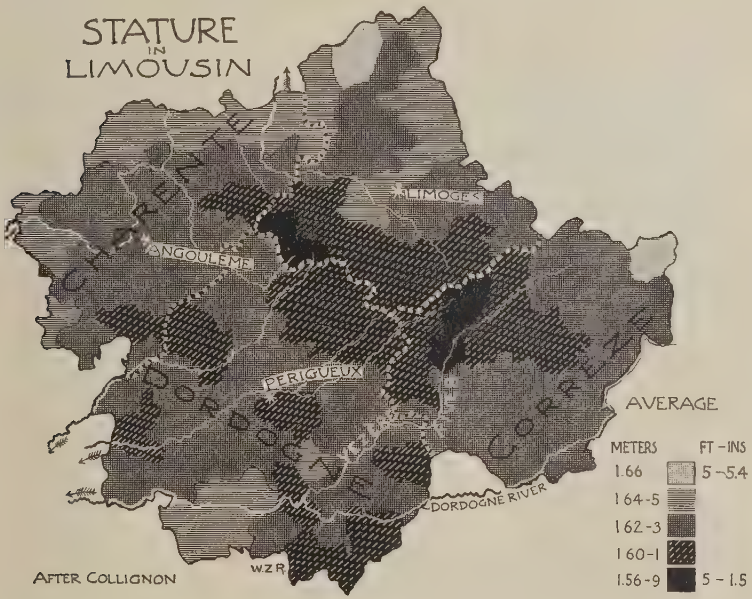
the heads are often more Teutonic in form than those of the peoples of direct Germanic descent along the Belgian frontier; nay, more, in some cantons the people outdo the purest Scandinavians in this respect. This region is also separated from all Teutonic centers across country by several hundred miles of broader-headed peoples. That disposes of the theory of colonization from the north across France. Could the Teutons have come around by sea, then, following the *litus Saxonicum* described in our last paper? Obviously not so; for, as we shall see, the deepest pit of long-headedness lies far inland, about the city of Périgueux. If this be due to immigrants, they certainly could not have come in ships. Is it possible, then, that the people of these departments could have come from the south, an offshoot of the Mediterranean type? If so, they must have come over the Pyrenees or else across the low pass down the course of the Garonne. In either case a great dike of brachycephaly must have been heaped up behind them, cutting off all connection with their base of racial supplies. And then, after all, we do not place too much reliance in any case upon theories of such wholesale bodily migration that populous departments among the largest in France are completely settled in a moment. Human beings in masses do not, as my friend Major Livermore has put it, play leap-frog across the map in that way, save under great provocation or temptation. We look for slow-moving causes, not cataclysms, just as the geologists have long since learned to do.



We may gain an idea of the reality of this curious phenomenon if we turn to our second map, in which the same region is charted in great detail. The head form is here given by cantons, small administrative divisions intermediate between the department and the commune or township. The location of the capital cities of Limoges and Périgueux, on both maps, will enable the reader to orient himself at once. The "key" shows the boundaries of the departments. It is clear that a series of concentric circles of increasing long-headedness—that is, of light tints upon the map—point to a specific area where an extreme human type is prevalent.

History offers no clew to the situation. The country in question, in Cæsar's time, was occupied by a number of tribes of whose racial affinity we know nothing. On the west dwelt the Santones by the present city of Saintes (ancient Saintonge). The city of Périgueux, which gave its name to the ancient province of Périgord, marks the territory of the Petrocorii of Roman times. The province of Limousin to the northeast of it was the home of the Lemovices, with their capital at the modern city of Limoges. Around the ancient city at Bordeaux lay the Bituriges and their allies the Medulli (Médoc). Along the east lay the Arvergni, whence the name Auvergne; together with a number of minor tribes, such as the Cadurci, giving name to the district of Quercy to-day. Unless the population has shifted extensively, contrary to all ethnological experience, the people whose physical origin is so puzzling to us included the tribes of the Lemovices and especially the Petrocorii. For these two covered the main body of narrow-headedness shown upon our map, extending over two thirds of the department of Dordogne, and up into Haute-Vienne and Charente beyond the city of Angoulême. It appears as if we had to do with two tribes whose racial origin was profoundly different from that of all their neighbors. The frontier on the southeast, between the Petrocorii and the Arverni, seems to-day to have been the sharpest of all. In places there is a sudden drop of over five units in cephalic index at the boundary lines. This means a change of type almost as great as that indicated between our two portraits on a preceding page. This is especially marked at the frontiers of the two modern departments of Corrèze and Dordogne, as our "key" map shows. This racial boundary finds no parallel in distinctness elsewhere in France, save between the Bretons and Normans. In this present case, the people are distinct because the modern boundaries coincide exactly with the ancient ecclesiastical and political ones. For centuries the Arverni in Corrèze have turned their backs upon the Petrocorii in Périgord on *fête* days, market days, at the paying of taxes, or examination of conscripts. This they did as serfs in the middle ages, and they do it to-day as freemen when they go to the polls to vote. Each has looked to its capital city for all social inspiration and support. The result has been an absence of intercourse, with its attendant consequences. Artificial selection has sharpened the contrasts imposed in the first instance by differences of physical descent. It is one of those rare cases where political boundaries are competent to perpetuate and even to accentuate natural peculiarities due to race.

Let us now concentrate our attention upon these two peoples clustering about the modern cities of Périgueux and Limoges respectively—separated alike from all their neighbors by their long-headedness. Closer inspection at once reveals that each of these two cities is to-day the kernel of a distinct subcenter of dolichocephaly; for two very light-colored areas surround each city, the two being separated by a narrow strip of darker tint upon our map. Along this latter line the cephalic index rises appreciably. Thus, for example, while only 78 about Limoges, and 76 or 77 in Dordogne, it rises on this boundary line to 80 and 81. In other words, a bridge of relative broad-headedness cuts across the map, setting apart the descendants of the Lemovices, at Limoges, from those of their contemporaries, the Petrocorii, about Périgueux. This means that we have to do with two distinct spots of long-headedness—a small one about Limoges, and a major

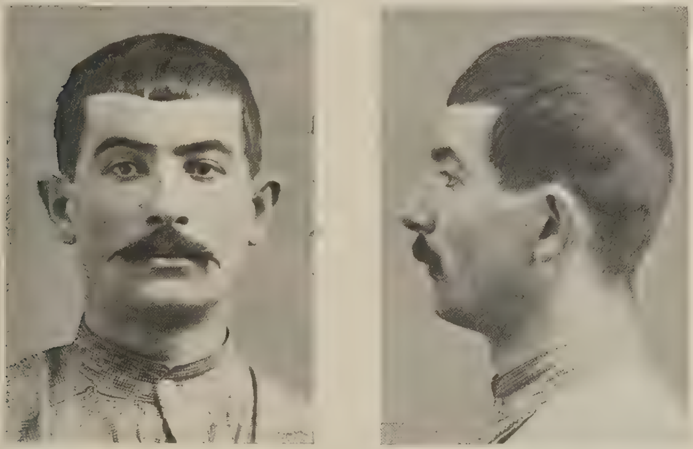


one extending all about Périgueux and Angoulême. There can be no doubt about this division. The boundary is a purely natural one, and deserves a moment's attention.

This frontier between Haute-Vienne and Dordogne lies along the crest of the so-called "hills of Limousin," made familiar to us already in another connection. It marks the watershed between the two great river systems of western France, the Garonne and the Loire. Our stature map of Limousin indicates the courses of these streams. Here is a true parting of the waters; for the Charente flows directly to the sea on the west; the affluents of the Loire run to the north; and the Vézère, part of the system of the Garonne, to the south. These hills of Limousin are the western outposts of the granitic area of Auvergne; and just here the country changes abruptly to a calcareous formation along the south and west. The district is accounted the very poorest in all France. Its soil is worthless even for grazing; the water is bad, and the climate harsh and rigorous.

These hills of Limousin, as we pointed out in a preceding paper, are, so to speak, a veritable watershed of stature as well. The bridge of relative broad-headedness we have described as lying along this line is but one among several peculiarities. The people of these hills are among the shortest in all Europe. Imagine a community whose members are so dwarfed and stunted by misery that their average stature is only about five feet two inches! Many cantons exist in which over thirty per cent of the men are under five feet three inches tall; and a few where two thirds of them all are below this height, with nearly ten per cent shorter than four feet eleven inches. With women shorter than this by several inches, the result is frightful. Around this area we find concentric circles of increasing stature as the river courses are descended and the material prosperity of the people becomes greater. Within it the regular diet of boiled chestnuts and bad water, with a little rye or barley; the miserable huts unlighted by windows, huddled together in the deep and damp valleys; and the extreme poverty and ignorance, have produced a population in which nearly a third of the men are physically unfit for military service. This geographical barrier, potent enough to produce so degenerate a population, lies, as we have said, exactly along the boundary between the descendants of the Lemovices about Limoges and the Petrocorii about Périgueux. To make it plain beyond question, we have marked the stunted area upon our map of cephalic index. The correspondence is exact. It also shows beyond doubt that this short stature is a product of environment and not of race; for our degenerate area overlies all types of head form alike, whether Alpine or other.

Here, then, is an anthropological as well as a geographical boundary, separating our long-headed tribes from one another. Without going into details, let it suffice to say that complexions change as well. To the north and east about Limoges the blond characteristics rise to an absolute majority, especially among the women; in the contrary direction, about Périgueux, the proportion of brunettes increases considerably. In short, the general association of characteristics is such as to prove that among the Lemovices there is a considerable infusion of Teutonic blood. They are the extreme vanguard of the Germanic invaders who have come in from the northeast. That accounts at once for their long-headedness. Similar to them are the populations west of Bordeaux in Médoc (*vide* key map). They also are remnants of the same blond, tall, long-headed type; but they have come around by sea. They are part of the Saxon hordes which have touched all along the coast of Brittany. These last people, settled in the beautiful Médoc and Bordelais wine country, protected by their peninsular position, are among the tallest peasantry of the southwest. They are, without doubt, the legitimate descendants of the Medulli and of the Nitiobriges Cubi and Vivisci of early times. But between these two colonies of the Teutons, about Limoges and in Médoc respectively, lies the one whose origin we have not yet traced. The Petrocorii about Périgueux, who were they ? If they also are of Teutonic descent, why are they not blond ? This they most certainly are not, for a noticeable feature of the population of Dordogne is the high proportion of black hair, rising in some cantons to twenty-seven per cent. This is very remarkable in itself, as even in Italy and Spain really black hair is much less frequent. This characteristic for a time gave color to the theory that this great area of dolichocephaly was due to the relics of the Saracen army of Abder-Rhaman, shattered by Charles Martel at the battle of Tours. It is not improbable that some Berber blood was thereby infused into the peasantry ; but this explanation does not suffice to account for other peculiarities, which a detailed investigation reveals.*



ALPINE TYPE. Landes. Cephalic Index, 90·4.

The most curious and significant trait of these long-headed people in Dordogne remains to be mentioned. A harmonic long and narrow head ought normally to be accompanied by an elongated oval visage. In the Teutonic race especially, the cheek bones are not prominent, so that an even smooth outline of the face results. In the Dordogne population, on the other hand, the faces in many cases are almost as broad as in the normal Alpine round-headed type. In other words, they are strongly disharmonic. To make this clear, compare the two heads shown in our illustrations.* Notice at once how the Cro-Magnon head is developed posteriorly as compared with the Alpine type. This is particularly noticeable in our second portrait on the next page. Observe also how in the front view the cranium narrows at the top like a sugar loaf, at the very place where the Alpine type is most broad. Yet despite this long head, the face is proportioned much more like the broad-visaged Alpine type than after the model of the young woman's face on page 441. Hers is a truly normal and harmonic dolichocephalic type.

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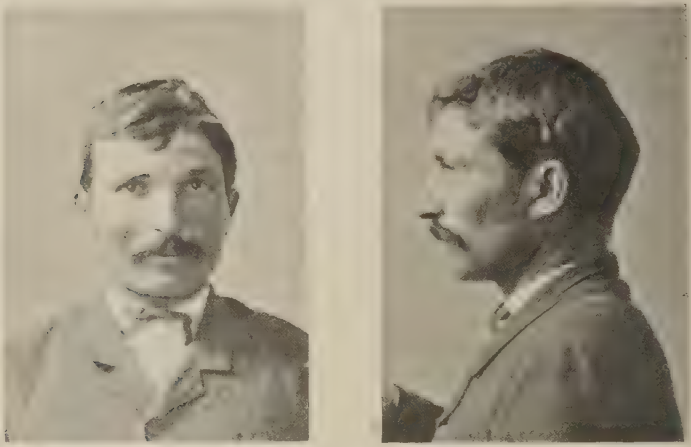
* G. Lagneau. On the Saracens in France. Memoirs of the Anthropological Society, London, vol. iii, pp. 157 *seq.*



Cro-Magnon Type. Dordogne. Cephalic Index, 78±.

In our Dordogne peasant there are many other minor features which need not concern us here. The skull is very low-vaulted; the brow-ridges are prominent; the nose is well formed, and less broad at the nostrils than in the Alpine type. These, coupled with the prominent cheek bones and the powerful masseter muscles, give a peculiarly rugged cast to the countenance. It is not, however, repellent; but more often open and kindly in appearance. The men are in no wise peculiar in stature. They are of medium height, rather stocky than otherwise. In this latter respect they show the same susceptibility to environment as all their neighbors: they are tall in fertile places and stunted in the less prosperous districts. Lying mainly south of the dwarfed areas of Limousin, they are intermediate between its miserable people and their taller neighbors in the vine country about Bordeaux. Let it be clearly understood that they are not a degenerate type at all. The peasants are keen and alert; often contrasting favorably with the rather heavy-minded Alpine type about them.

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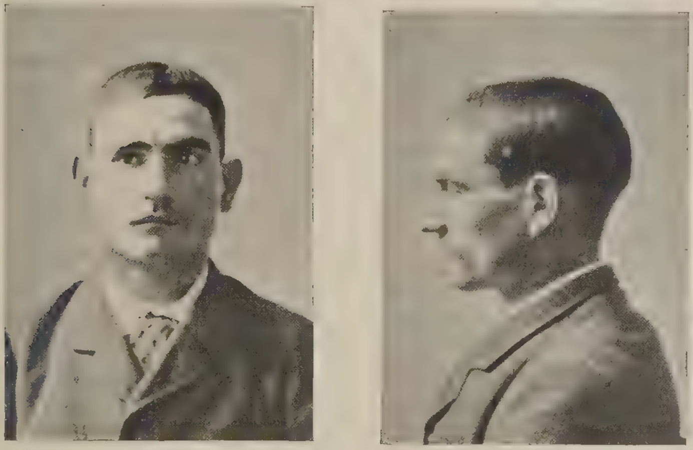
* For the Cro-Magnon portraits on this and the following pages I am indebted to Dr. Collignon himself. These are the first, I think, ever published, either here or in Europe.

The people we have described above agree in physical characteristics with but one other type of men known to anthropologists. This is the celebrated Cro-Magnon race, long ago identified by archæologists as having inhabited the southwest of Europe in prehistoric times. As early as 1858 human remains began to be discovered by Lartet and others in this region. Workmen on a railway in the valley of the Vézère, shown on our map, unearthed near the little village of Les Eyziès the complete skeletons of six individuals—three men, two women, and a child. This was the celebrated cave of Cro-Magnon. In the next few years many other similar archæological discoveries in the same neighborhood were made. A peasant in the upper Garonne Valley, near Saint-Gaudens, found a large human bone in a rabbit hole. On excavating, the remains of seventeen individuals were found buried together in the cave of Aurignac. At Laugerie Basse, again in the Vézère Valley, a rich find was made. In the cave of Baumes-Chaudes, just across in Lozère, thirty-five human crania with portions of skeletons were unearthed. These were the classical discoveries; the evidence of their remains has been completely verified since then from all over Europe. In no district, however, are the relics of this type so plentiful as here in Dor-



Cro-Magnon Type. Dordogne. Cephalic Index, 77±.

dogne. Eight sepulchral caves have been discovered within as many miles of the village of Les Eyziès alone in the Vézère valley. Because of this geographical concentration of a peculiar type in this region, it has become known by the name of the Cro-Magnon race, since in the cave of this name the most perfect specimens were found.

The geographical evidence that here in Dordogne we have to do with the real Cro-Magnon race is fully sustained by a comparison of the physical characteristics of the crania here discovered in these caves in the valley of the Vézère with the peculiar living type we have above described. The original Cro-Magnon race was extremely dolichocephalic; as long-headed, in fact, as the modern African negroes or the Australians.* The cranial indices varied from 70 to 73, corresponding to a cephalic index on the living head between 72 and 75. This was and is the starting point for the theory that the Mediterranean populations are an offshoot and development from the African negro. The only other part of Europe where so low an index has been located in the living population is in Corsica, where it descends almost to this level. The people of Dordogne do not to-day range quite as long-headed as this, the average for the extreme commune of Champagnac being 76. This difference need not concern us, however, for within the whole population are a large proportion with indexes far below this figure. Close proximity to the very brachycephalic Alpine type, just over the line in Corrèze, would account for a great deal larger difference even than this. Probability of direct descent becomes almost certainty when we add that the Cro-Magnon head was strongly disharmonic, and very low-skulled. The modern population does not equal its progenitors in this last respect, but it approaches it so distinctly as to show a former tendency in this direction. The skull was elongated at the back in the same way—a distinguishing trait which appears prominently upon comparison of the profile view of a modern Cro-Magnon type with that of its Alpine neighbors, as we have already observed. The brows were strongly developed, the eye orbits were low, the chin prominent. The noted anthropologist, De Quatrefages, prophesied what one of these types ought to look like in the flesh. I give his description in his own words, that its agreement with the facial type above represented may be noted: "The eye depressed beneath the orbital vault; the nose straight rather than arched, the lips somewhat thick, the maxillary (jaw and cheek) bones strongly developed, the complexion very brown, the hair very dark and growing low on the forehead—a whole which, without being attractive, was in no way repulsive." *

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* Quatrefages and Hamy, Crania Ethnica, p. 46 *seq.* See also Quatrefages, The Human Species, in Appletons' International Scientific Series. The best collection of material in small compass, with references, is given by Salmon in Revue Mensuelle de l'École d' Anthropologie, V, 1895, pp. 155 and 214 *seq.* Bertrand, in La Gaule avant les Gaulois, Paris, 1891, has mapped these finds of the reindeer period. The correspondence with our modern population is very close.

The prehistoric antiquity of the Cro-Magnon type in this region is attested in two distinct ways. In the first place, the people possessed no knowledge of the metals; they were in the same stage of culture as, perhaps even lower than, the American aborigines at the coming of Columbus. Their implements were fashioned entirely of stone, although it was often cunningly chipped and even polished. They were ignorant of the arts, either of agriculture or the domestication of animals, in both of which they were far below the culture of the native tribes of Africa at the present day. Additional proof of their antiquity was offered by the animal remains found intermingled with the human bones. The climate must have been very different from that of the present, for many of the fauna then living in the region, such as the reindeer, are now confined to the cold regions of northern Europe. To be sure, the great mammals, such as the mammoth, mastodon, the cave bear, and hyena, had already become extinct. They were contemporaneous with a still more ancient and uncultured type of man, whose remains occur in a lower geological stratum. This Cro-Magnon race is not of glacial antiquity, yet the distribution of mammals was markedly different from that of to-day. Thus of nineteen species found in the Cro-Magnon cave, ten no longer existed in southern Europe. They had migrated with the change of climate toward the north. The men alone seem to have remained in or near their early settlements, through all the changes of time and the vicissitudes of history. It is perhaps the most striking instance known of a persistency of population unchanged through thousands of years.

It should not be understood that this Cro-Magnon type was originally restricted to this little region alone. Its geographical extension was once very wide.† The classical skull of Engis, in Belgium, so well described by Huxley in Man's Place in Nature, was of this type. It has been located in places all the way from Tagolsheim and Bollwiller in Alsace to the Atlantic on the west. Ranke asserts that it occurs to-day in the hills of Thuringia, and was a prevalent type there in the past. Its extension to the south and west was equally wide. It was the type common among the extinct Guanches of the Canary Islands. Dr. Collignon has iden-

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* For description of modern representatives of this type, *vide* Quatrefages, in Bulletins Société d'Anthropologie, 1876, pp. 408–417.

† Dr. Verneau. La Race Cro-Magnon, in Revue d'Anthropologie, 1886, p. 10 *seq.*

tified it in northern Africa. From all these places it has now disappeared more or less completely. Only in two or three other localities does it still form an appreciable element in the living population. There is one outcrop of it in a small spot in Landes, farther to the southwest, and another away up in Brittany, in that peculiar population at Lannion which we left in our last article with a promise to return to it. On the island of Oloron off the west coast there seems to be a third survival. A very ancient type has also been described by Virchow in the islands off northern Holland, which is quite likely of similar descent.

In all these cases of survival above mentioned, geographical isolation readily accounts for the phenomenon. Is that also a competent explanation for this clearest case of all in our population in Dordogne? Why should these peasants be of such direct prehistoric descent as to put every ruling house in Europe to shame? Has the population persisted simply by virtue of numbers, this having been the main center of its dispersion in prehistoric times? Or is it because of peculiarly favorable circumstances of environment? It certainly is not due to isolation alone, for this region has been overrun with all sorts of invaders, during historic times at least, from the Romans to the Saracens and the English. Nor is it due to economic unattractiveness; for, be it firmly fixed in mind, the Cro-Magnon type is not localized in the sterile Limousin hills, with their miserable stunted population. It is found to-day just to the southwest of them in a fairly open, fertile country, especially in the vicinity of Bordeaux. These peasants are not degenerate; they are, in fact, of goodly height, as indeed they should be to conform to the Cro-Magnon type. In order to determine the particular cause of this persistence of an ancient race, we must broaden our horizon once more, after this detailed analysis of Dordogne, and consider the whole southwest from the Mediterranean to Brittany as a unit. It is not impossible that the explanation for the peculiar anomalies in the distribution of the Alpine stock hereabouts may at the same time offer a clew to the problem of the Cro-Magnon type beside it.

The main question before us, postponed until the conclusion of our study of the Dordogne population, is this: Why has the Alpine race in the southwest of France, in direct opposition to the rule for all the rest of Gaul, spread itself out in such a peculiar way clear across the Garonne Valley and up to the Pyrenees? It lies at right angles with the river valley instead of along it. In other words, why is not the Alpine type isolated in the unattractive area of Auvergne instead of overflowing the fertile plains of Aquitaine? The answer is, I think, simple. Here in this uttermost part of France is a last outlet for expansion of the Alpine race repressed on every side by an aggressive alien population.

It has merely expanded along the line of least resistance. The Alpine type in Auvergne, increasing in numbers faster than the meager means of support offered by Nature, has by force of numbers pushed its way irresistibly out across Aquitaine, crowding its former possessors to one side. Certainly this is true in the Pyrenees, for here at the base of the mountains the population changes suddenly, as we shall see in our next paper on the Basques. On the other side at the north lies, as we have just seen, a second primitive population, less changed from the prehistoric type than any other in Europe. This Cro-Magnon race has been preserved apparently by the dike of the Limousin hills with their miserable population; for these hills have cut across the Paris-Bordeaux axis of fertility and have stopped the Teutonic race at the city of Limoges from expanding farther in this direction—that is to say, economic attraction having come to an end, immigration ceased with it. The intrusive Teutonic race has therefore been debarred from this main avenue of approach by land into Aquitaine. The competition has been narrowed down to the Alpine and Cro-Magnon types alone. Hence the former, overflowing its source in Auvergne, has spread in a generally southwestern direction with slight opposition. It could not extend itself to the southeast, for the Mediterranean type was strongly intrenched along the sea coast, and was in fact pushing its way over the low pass into Aquitaine from that direction. The case is not dissimilar to that of Burgundy, for in both instances a bridge of Alpine broad-headedness cuts straight across a river valley open to a narrow-headed invasion at both ends. It is not improbable that in both this bridge is a last remnant of broad-headedness which would have covered the whole valley had it not been invaded from both sides by other competitors.

Enough has been said to show the complexity of the racial relations hereabouts. We have identified the oldest living race in this part of the world. The most primitive language in Europe—the Basque—is spoken near by. It will form the subject of the next paper.

In his journeyings in the Zambesi country, Africa, Captain A. St. H. Gibbons found an ancient and interesting custom prevailing at Nalolo of investing the eldest surviving sister of the ruling king with the prerogatives of a queen, without whose advice and sanction her brother can not give effect to any important measure in the government of the state. In minor local matters she in her own district reigns supreme, holds the power of life and death over her subjects, and is at liberty to wed or depose a husband at will. The present *Makwai*, or queen, from whom six husbands have been removed in ways not natural, is described by the author as having a mixed character, being unscrupulous and very polite.

NEW QUESTIONS IN MEDICAL JURISPRUDENCE.

By T. D. CROTHERS, M. D.

THE startling revelations in the scientific world are repeated in some degree in the sudden opening up of a new territory of medico-legal science, the jurisprudence of inebriety. Within five years the question of the mental soundness of the inebriate and his capacity to act or reason normally has been raised with increasing frequency in a great variety of criminal and civil cases. The rapid advances in psychological studies fully sustain the wisdom and necessity of scientific inquiry in this field. The medical profession has been suddenly called to determine facts and their meaning, and give advice along this new line of inquiry, without precedent, and opposed by public opinion and deep-rooted prejudice, and hence are often plunged into great doubt and confusion. As a result, the strangest theories prevail as to what inebriety is and is not, theories of moral and legal accountability and responsibility, that presuppose a degree of psychological knowledge that can only be obtained after centuries of further study.

To-day there are hundreds of persons awaiting trial or sentence for crime committed when poisoned by alcohol. There are hundreds of business contracts disputed and contested by law, made when the parties were intoxicated. There are hundreds of wills whose validity is questioned for the same reason. There are hundreds of divorce suits where the inebriety of the parties is the vital question on which the issue of the case turns.

Although these topics have so recently come into medicolegal notice, and are so complicated with theories and superstitions, yet they have already divided into three distinct theories or points of view:

First, the *ethical* and *moral* view, which seeks an explanation of inebriety from the teaching of Scripture and the opinions of theologians and metaphysicians. This view asserts that inebriety is only a phase of moral depravity innate in every life, and one that is susceptible of great growth and development, by willful neglect and gratification of all the animal instincts. Medicolegally the remedy is severe punishment, increased responsibility, prayer, conversion, and the application of moral suasion.

The *second* is the *legal* view, which is practically an outcome or result of the moral theory. It assumes that inebriety is a phase of savagery or the inborn tendency to lawlessness and giving up of all control and restraint; or the indulgence of the lower passions regardless of society, law, and order. The legal remedy is severe punishment, increased penalties, and suffering.

The theory is to develop the higher nature of man by causing pain and suffering in the lower nature; in this way to rouse up the brain and will power to regain control of the animal part. Three hundred years ago Lord Coke, of England, held that inebriety always aggravated the offense, and the punishment should rather be increased. This has been the corner-stone of the legal view of inebriety up to very recent times.

The third theory is the scientific and medical view. This affirms inebriety to be a physical condition, the tendency of which is often inherited and also acquired; that this physical condition is always a disease, a modified or pronounced form of insanity. In other cases it is a positive symptom of insanity; also, it is a form of brain degeneration that, like other diseases, has distinct causes, development, progress, and decline. It is also urged that the continuous use of alcohol always causes disturbances of brain circulation, and is followed by brain congestion, brain paralysis, and impaired senses; the result of which is incapacity to realize the nature and character of acts, the judgment is defective, and the control is lessened and is not normal. Medico-legally this theory regards the inebriate as diseased and incapacitated to act sanely, to be treated as a sick man and placed under medical and legal care and control, until recovery or for life.

The first two theories assume perfect sanity in all cases of inebriety, and assert that the remedy is to be more severe punishment, and accountability to law and society. The third theory recognizes a physical condition, and demands a scientific study of each case before the remedy or treatment can be determined. Another theory has been asserted, that in some cases inebriety was a vice at first, then later a disease; that in some cases punishment is the remedy, and in others medical care and treatment. Such are some of the theories and standpoints from which the subject of inebriety is approached medico-legally.

The confusion and doubt of the exact nature of inebriety is due in a large part to the failure to study these cases independently. The dictum of judges, the teachings of theologians, newspaper views, and public opinion, are too often the sources from which medical men derive their views. This was very apparent in a contested will case, where five medical men testified to the mental capacity of a chronic inebriate who willed his property to a mistress. The judge declared he should act on his own judgment, and decide the man unsound and incapable. A man set fire to a church without apparent motive. Three physicians swore to his sanity, although he had delirium tremens repeatedly and was a chronic inebriate, and intoxicated at the time. The jury decided otherwise.

Questions involving the capacity or incapacity of inebriates can never be determined by any metaphysical theory of mind or morals.

One of the very obscure questions which have recently come into legal prominence has been called the alcoholic trance state. The frequent statement of prisoners in court, that they did not remember anything about the crime they are accused of, appears from scientific study to be a psychological fact.

It is well known to students of mental science that in certain unknown brain states memory is palsied, and fails to note the events of life and surroundings. Like the somnambulist, the person may seem to realize his surroundings and be conscious of his acts, and later be unable to recall anything which has happened. These blanks of memory occur in many disordered states of the brain and body, but are usually of such short duration as not to attract attention. Sometimes events that occur in this state may be recalled afterward, but usually they are total blanks. The most marked blanks of memory have been noticed in cases of epilepsy and inebriety. When they occur in the latter they are called *alcoholic trances*, and are always associated with excessive use of spirits. Such cases are noted in persons who use spirits continuously, and who go about acting and talking sanely although giving some evidence of brain failure, yet seem to realize their condition and surroundings. Some time after, they wake up and deny all recollection of acts or events for a certain period in the past. This period to them begins at a certain point and ends hours or days after, the interval of which is a total blank, like that of unconscious sleep. Memory and certain brain functions are suspended at this time, while the other brain activities go on as usual.

Probably the largest number of criminal inebriates who claim loss of memory as a defense for their acts are the alcoholic dements. These are chronic inebriates who have used spirits to excess for years. This, with bad training in early life, bad surroundings, and bad nutrition, have made them of necessity unsound, suffering from many and complex brain defects. Such persons are always more or less without consciousness or realization of their acts. They act automatically, only governed by the lowest and most transient impulses. Crimes of all kinds are generally accidents growing out of the surroundings, without premeditation or plan. They are incapable of sane reasoning or appreciation of the results of their conduct. The crime is unreasoning, and general indifference marks all their acts afterward. The crime is along lines of previous conduct, and seldom strange or unusual. The claim of no memory in such cases has always a reasonable basis of truth in the physical conditions of the person.

The second group of criminals who claim no memory are those where the crime is unusual, extraordinary, and unforeseen. In such cases the trance condition may have been present for some time before and escaped any special notice, except the mere statement of the person that he could not recollect his acts. The unusual nature of the crime, committed by persons who never before by act or thought gave any indication of it, is always a factor sustaining the claim of no memory. The explosive, unreasoning character of crime always points to mental unsoundness and incapacity of control.

A third group of criminals urge this statement of no memory. They are positive inebriates, drinking to excess, but not to stupor, who suddenly commit crime with the most idiotic coolness and indifference, never manifesting the slightest appreciation of the act as wrong, or likely to be followed by punishment. Crime committed is never concealed, and the criminal's after conduct and appearance give no intimation that he is aware of what he has done. These cases have been termed moral paralytics, and the claim of the trance state may be true.

A fourth group of cases where memory is claimed to be absent occurs in dipsomaniacs and periodical inebriates, who have distinct free intervals of sobriety. This class begin to drink to great excess at once, then drink less for a day or more, and begin as violently as ever again. In this short interval of moderate drinking some crime is committed of which they claim not to have any recollection.

Other cases have been noted where a condition of mental irritation or depression preceded the drink explosion, and the crime was committed during this premonitory period and before they drank to excess. The strong probability of trance at this period is sustained by the epileptic character of such conduct afterward. The trance state may be justly termed a species of *aura*, or brain paralysis, which precedes the explosion.

In some instances, before the drink storm comes on, the person's mind would be filled with the most intense suspicions, fears, delusions, and exhibit a degree of irritation and perturbation unusual and unaccountable. Intense excitement or depression, from no apparent cause, prevails, and during this period some crime may be committed; then comes the drink paroxysm, and later all the past is a blank. In these groups the crime is generally automatic, or committed in a manner different from other similar crimes. Some governing center has suspended, and all sorts of impulses may merge into acts at any moment. The consciousness of such acts and their consequences is practically destroyed.

One of the questions which has become prominent recently in many cases is as follows: How far can the testimony of inebriates or persons under the influence of spirits be trusted concerning matters observed in this condition?

This question called for an answer in the following cases:

1. An inebriate physician, partially intoxicated, witnessed an assault, and swore to the identity and exact part which the accused was supposed to have taken in the crime.

2. A barkeeper, partially intoxicated at the time, swore to the particular man who shot another in a crowd, where several shots were fired by different persons.

3. A man under the influence of spirits testified that he saw the person accused put fire to a building which was burned down.

4. A man on his way home from a saloon, where he had spent the evening drinking, identified a man in the courtroom whom he asserted he had seen breaking into a house.

In these cases the medical witness was asked, What, in your opinion, as an expert, based on the statements of the witness, and the circumstances of the case, was the condition of the witness's mind as to the power of clearly observing and remembering the facts and incidents to which he has testified? Also, do you believe in these cases that the witness was competent to observe and clearly remember the incidents to which he has sworn?

If the medical expert has formed no higher opinion of inebriety than that it is a vice in the moral sense, and alcohol produces a state of exhilaration, his answer will be unsatisfactory; but if he is a scientific student he will form a general conclusion which will at least approximate very near to the real facts. In arriving at the facts the medical witness must start from some general principles which are recognized as established beyond question.

First, the action of alcohol is always that of an anæsthetic, benumbing and paralyzing (1) the nerve function and the consciousness of nerve impression; (2) the power of co-ordinating and regulating these impressions; (3) the reasoning or capacity of comparing acts and events is disturbed. Thus both the sense impressions and the power of analyzing and correctly estimating them are impaired. This takes place in all cases, depending on the amount and quality of spirits taken: where intoxication follows, these effects are very clear; but where a smaller amount of spirits is taken, and only partial intoxication is present, they are not so prominent. It is present in those who use alcohol continuously, and is noted as a general diminution of brain and sense acuteness. In active life, brain workers, trained experts, and all persons whose work requires delicate nerve adjustment and accuracy of brain and muscle work, soon find the use of alcohol impairing their powers, and abandon its use, especially when they are called to do any particular work. The musician, the actor, the scientist, and the professional and business man very quickly discover the impairments which follow from the use of alcohol, not only over the senses, the volition, the nerve and muscle co-ordination, but the power of clearly realizing the relation of events. The increased action of the heart from alcohol is of short duration, and is surely followed by diminished sensibility and anæsthesia.

The vigor and strength supposed to come from alcohol quickly merge into weakness and debility. Hence, the man who is visibly poisoned by alcohol, however slight the degree, has defective senses, defective nerve impressions, defective co-ordination, and defective reasoning. He is literally suffering from the first stages of paralysis, which begins with the senses. He can neither see nor discriminate accurately; he is always open to the possibility of false impressions and false conclusions, and is unable to correct them. His senses may be but little impaired, but his power of comparison, of analyzing events and their meaning, is faulty. He has anæsthesia of the higher brain centers, which does not appear except from close observation.

From these general facts the study of the individual case resolves itself into a question of how far the person used spirits, and how much he had drank at or about a certain specified time; also the circumstances, conditions, and surroundings of the act in question, and the statement of the man; from this a medical witness can draw accurate conclusions.

In the two murder cases referred to, other testimony made the statement of the drinking witness doubtful. In the third case a clear alibi was established by the accused. In the other cases, although the evidence of the witness was accepted, there was a strong probability of mistake. The conclusion, which appears to be sustained by all the facts and scientific study of these cases, is as follows:

The testimony of persons while under the influence of spirits, concerning matters observed by them, and their judgment as to events and their meaning, are never accurate, but always open to sources of error and unconsious self-deception which they are unable to correct.

The medical expert should have no hesitation in denying the value and truthfulness of all such testimony.

A second question which has come up recently along this same line of research is more difficult and requires more accurate psychological and physiological study.

It is this: How far are the statements or confessions of persons partially intoxicated, or under the influence of spirits, concerning their personal acts to be accepted as true and veritable?

An answer to this question was sought in the following cases:

First. An inebriate shot and killed his partner while under the influence of spirits. At the station house, soon after, he made a confession, which reflected very severely on him. On the trial the statement of the crime was not sustained, but contradicted in many ways.

Second. A man was found drowned, and a drinking friend confessed to have pushed him into the water while in a state of intoxication. This confession was clear in its details, and he seemed very earnest and contrite. It was accepted as true, and he was sentenced to prison for life. Subsequently it was found that the drowning was accidental, and the confessed murderer was miles away sleeping at this time, suffering from alcoholic stupor. A few hours later he came to the scene of the drowning, and at once came to the conclusion that he had committed the crime.

A *third* case was that of a man who, after drinking all the evening in a saloon, saw on his way home after midnight a deadly encounter with a burglar in the hall of a house he was passing. He was taken to the station house and, after a series of questioning, identified the burglar, and swore to many details of the crime. This was found to be untrue, although he adhered very closely to the details and urged their truthfulness. In reality he had been told what he saw by the officer, whose suggestive questions made up the entire statement.

The medical questions in these cases were answered from the assumption that the use of alcohol, unless to stupor, does not impair the senses and reason on matters that concern the personal acts and conduct. It was assumed that any statements or confessions of crime that did not peril the freedom and safety of the man could have no other motive except that of the promptings of a wounded consciousness to repair the injury. It was assumed that no man under the influence of spirits, not stupidly intoxicated, would ever confess to acts not committed, or ever delude himself with such impressions, especially as at this time the brain was in a state of increased activity. All these assumptions were wrong, and contradicted by the facts. The man under the influence of spirits is always semiparalyzed; his brain is in a confused state, and never guided or controlled by natural, healthy motives; his senses and judgment are weakened, and the repetition of any statement which may impress him may soon seem a reality which he is never able to correct. His mind is open to all sorts of morbid impressions which quickly appear like realities.

In the lower courts these special phases of brain palsies are seen in the confessions and sworn statements of acts and events observed that are often found to be absolutely false. The conclusion is evident that no testimony, statement, or confession of a person under the influence of spirits concerning his acts, conduct, or motives has any value or can be trusted unless sustained by collateral and other evidence.

A third question along this line of inquiry has also become prominent during the year: How far shall an inebriate, or man under the influence of spirits, be held liable for any acts or contracts, such as wills, marriages, or bargains?

The questions the medical man is asked are these: How far is the person in this state capable of appreciating the nature and consequences of his acts? Was his mind in any way impaired to that extent as to be unable to clearly realize his duty and obligations to himself and others? Was the act sane in its execution and reasonable consequences? These questions came up for an answer in the following cases: An inebriate who had drank at intervals for twenty years had made a will disposing of a large property, and had repeatedly mentioned its terms with pleasure and satisfaction. At his death it was found that he had made another will giving most of his property to the Freedman's Bureau for the education of colored children. He had been a very miserly man all his life, and this was an unusual act. The will was made after a drink period, and he seemed to the lawyer and witnesses sober and fully conscious of what he was doing. The medical men held that the use of spirits had not weakened his mind or rendered him incompetent to dispose of his property.

In a *second* case, a man who drank to excess at intervals bought a large interest in a traveling circus while under the influence of spirits. He seemed perfectly sane at the time, yet the act was unusual, and he sought to annul the contract, claiming that he was subject to undue influence.

The testimony of medical men as to the probable state of the mind when these acts were performed is the central evidence upon which the issue of each case must turn. The necessity of thorough scientific study of the mental condition of men who use spirits at intervals or continuously, and the application of all the facts that enter into the history of the cases in question, is imperative.

The question of premeditation in the drink paroxysms is a subject of much confusion in many cases.

The frequent instances where inebriates, in apparent possession of good judgment, go away and drink to great excess, displaying a degree of forethought and premeditation fully characteristic of all the ordinary events of life, are often very confusing to the ordinary observer. When the drink paroxysm comes all unexpectedly upon the victim, in some unforeseen state and circumstance, and he falls, it is apparent that he is suffering from some unstable or diseased brain state, which has burst out from the application of some exciting cause. But when the paroxysm is anticipated and prepared for, and all the surroundings are made subservient to this end, when every facility to procure spirits is increased, when money is secured and business arrangements are made in view of this coming paroxysm, the conclusion most commonly reached by all non-expert observers is that it is deliberate vice and wickedness. When the history of a number of these cases is studied and compared, they are found to be well-marked cases of reasoning insanity, with drink paroxysms. These paroxysms are the acute attacks—the deliriums which expend themselves like storms that gather and burst—and are preceded by long periods of rest.

Several very noted cases of capital crime by inebriates have brought out this fact of premeditation, with conviction, on the theory that disease and insanity were incompatible with power of conceiving and coolly executing crime. This theory is opposed by the facts in the history of the following case: A business man, who had drank at intervals to excess for ten years, had a preliminary period of moderate drinking before the stupor or the delirium of the paroxysm of drink. During this time he continued his business as usual, but to his confidential friends he explained various schemes of revenge, in which he wished to punish persons who had injured him in business. These plans were skillfully and shrewdly arranged, and indicated a clear, unusual conception of causes and effects. The reasons for these acts were delusional, and based on strained inferences. His friends advised delay, and after the drink paroxysm his recollections of these plans became indistinct, and his interest passed away. He treated them as crazy notions, and was ashamed to consider or talk about them. These delusions only appeared when he began to use spirits, and were concealed and only mentioned to his most intimate friends. This scheme of revenge comprised arson and murder, and the execution required a combination of studied acts that would mislead and mystify others. With but little encouragement he would have committed this crime, and premeditation and malice could have been clearly brought out in the trial.

In a second case a periodical inebriate, whose preliminary period lasted from two to three weeks, planned a bank swindle. At about the time of its consummation he drank to great excess, having the usual paroxysm, then recovered and denied all knowledge of this event. While the act was very unusual and opposed to all his previous conduct and character, yet during the time it was planned he appeared to be very clear and fully conscious of the nature and character of the act. The probability is that all acute reasoning and display of full consciousness of the act and its consequences are based on delusions, either concealed or openly confessed. The action of alcohol seems to suspend some governing center, and capacity to discriminate the folly of the act. The mind appears to be eclipsed, and previous standards of truth and honor are overshadowed. All the former vigor remains, or appears to be intact; judgment and reason display vigor and clearness in criminal acts and conduct. Motives and purposes of life have changed, although the form and semblance of the past conduct remain.

Innumerable illustrations are seen among petty criminals, so called, where the acts have preceded the drink craze, and always been executed while the victim was using spirits in small quantities. Premeditation, acute reasoning, and apparent consciousness of acts and their consequences, preceding a drink excess, either associated with a moderate use of spirits or immediately before spirits are used in excess, should always be regarded as symptoms of mental derangement.

The use of spirits for the purpose of committing crime is another disputed question in courts.

Crimes which are supposed to have been committed by persons who deliberately used spirits for this special purpose are commonly found to have been stimulated and provoked by other causes. To give spirits to a person and encourage him to commit crime may not be an unusual occurrence, but its consummation is an accident and exceedingly uncertain. On general principles the natural tendency of an inebriate's mind is to ignore all restraint and obligation, legal, social, and moral. The higher governing centers are depressed and more or less paralyzed. The senses are deranged, and false impressions are constantly received, and the power of analysis and reason is diminished and broken up. All higher relations of duty are obscured, and only the lowest, most transient impulses control the mind. At this time temptations to acts that are criminal, urged on the bewildered mind, may be acted upon, from simple incapacity to reason and understand the consequences. This blurred mental state is of short duration, and merges quickly into anæsthetic physical and mental states, or delusional conceptions, of which fear and suspicion are prominent. The use of spirits to give courage to commit crime very often produces the opposite effect, particularly where an interval occurs between the use of spirits and the performance of the act.

The courage or stimulation of the first stage from the action of alcohol on the brain is of short, uncertain duration, and liable any moment to change to abject fear or other states.

There are two conditions in which crime is committed by persons who drink spirits for this purpose: one, where they become the agents of others, and accept and carry out the plans arranged for them, either tacitly as by power of compulsion of an idea, or desire to please another; secondly, the act is the materialization of a delusion which has existed before and has been stimulated into activity by the use of spirits. In the first case some hypnotic state, in which an idea becomes dominant, exists. But this is very unstable, and while it may be increased by alcohol, is uncertain in duration, and liable to change any moment. Thus in a case where a man who, after using spirits, developed delusions of suspicion that his partner was robbing him, this was increased by giving him more spirits and reiterating the idea, and suggesting criminal revenge. It was noticed that there was a certain brief period when he might execute a criminal act, but before and after it was very doubtful. The brain could not be depended upon: it might act in an entirely different way and from a different motive apparently. Alcohol clearly predisposes to criminality by lowering and paralyzing the higher brain centers which preside over consciousness of right and wrong. The immediate effect of spirits is to cause impulsive, petty acts. For the present moment such acts might materialize into serious crime, but it would depend upon favorable conditions and surroundings. The unstable condition of the brain made so by alcohol, is more or less incapable of sustaining a preconceived idea and carrying it out, especially if time and continuous drinking follow. This is the rule to which there are exceptions, but these exceptions clearly follow certain circumstances which are easily traced. Often it is claimed that spirits are given for the purpose of obtaining undue influence in the making of a will or signing a contract. This is confirmed by a clinical study of cases, and facts indicate the impulsiveness of the act, with absence of deliberation or forethought. Delusions and misconceptions of acts and motives are very common in all inebriates. Faulty reasoning, childish credulity, and general failure of capacity to discriminate and adjust himself to the conditions and surroundings, must of necessity result in wrongdoing; although in many cases this condition is covered up, and only when the person acts along unusual lines is it apparent.

All contracts and wills written by inebriates should be subjected to careful scrutiny. Not infrequently such acts display sound judgment, and it is found that they are the culmination of previous conceptions. Where they manifest imbecility and strange motives, it is clearly the workings of an anæsthetic brain, acting from suggestions from without or deranged impulses formed within. While a very large number of inebriates act rationally in ordinary affairs of society and business, and do not commit overt acts that come under legal recognition, it is a question if this is not the result of accident and conditions. There are strong reasons for believing that a slight change of surroundings both mental and physical would explode the degeneration which exists and bring to light insanity, criminality, or idiocy. Instances are not infrequent of acts of lawlessness and crime in inebriates previously law-abiding and honest citizens. It was not the last use of spirits which provoked the act; this only exploded a condition which had been gathering like a storm long before. The direction and form which this disturbance would take could not always be foreseen.

The designing man who gives spirits and suggests crime and wrongdoing is in peril of being the victim himself. He is practically exploding a state of insanity, and trusting that he may be able to control it.

The inebriate or moderate drinker who uses spirits to give courage to commit some act makes the same blunder of supposing that he can paralyze the higher governing centers and still direct and control the lower faculties. Where imperative ideas and delusions already possess the brain, alcohol may intensify them for a time, but confusion and uncertainty of thought and act are inevitable.

The claim that alcohol is used for the purpose of committing crime should be a question open for evidence, and one to be considered doubtful until proved by facts that can have no other meaning. Crime committed when under the influence of spirits will be found as a rule to follow uniform lines and be very much alike in methods of execution. If spirits have been used for the special purpose of facilitating the commission of crime, very wide differences will appear. No two cases will be alike, and doubt and uncertainty will complicate the factors in every case.

These are some of the many new questions coming into prominence in the courtroom with increasing frequency every year. The present obscurity and confusion of law rulings and medical theories will be cleared away in the near future, when the subject is studied from the scientific point of view.

L'ÉLEVEUR, of Paris, has a story of a heron in England which, having lost its mate, sought consolation in constituting itself a kind of shepherd for the village. It brought the cattle to the stables, and took upon itself the supervision of the poultry, adjusting all the quarrels, and driving away unruly members of the brood. It also assumed the charge of the horses when they were harnessed, and at the first sign of restiveness restored them to quiet by giving them a peck in the nostrils. One day, when two calves had escaped, the heron, having tried unsuccessfully to drive them back, remained near them and watched them till the men came in search of them.

PRINCIPLES OF TAXATION.

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IX.—NOMENCLATURE AND FORMS OF TAXATION.

(*Continued from page 185.*)

THE nature and scope of the "legal" and wholly anomalous definition (to which reference has been made, see page 173) that has been given in the United States by its Supreme Court to a *direct* tax,* and the interesting judicial and historical circumstances in connection therewith are substantially as follows:

The Constitution of the United States provides that "representatives and direct taxes shall be apportioned among the several States according to their respective numbers"—that is, population—"and excluding Indians not taxed." The origin of the idea thus incorporated in the Constitution of proportioning direct taxes according to representation, or population, rather than upon property, is not certainly known, and has been made the subject of speculation. Hamilton, subsequent to the adoption of the Constitution, suggested that the writings of the French economists of the eighteenth century, with which a number of the prominent members of the Constitutional Convention were familiar, was its source. These held that "agriculture was the only productive employment, and that the net product from land, to be found in the hands of the landowner, is the only fund from which taxation can draw without impoverishing society." They were accordingly led to class taxes habitually as direct when laid immediately upon the landowner, and as indirect when laid upon somebody else, but in their opinion destined to be borne by the landowner ultimately. Precedents for levying taxes by apportionment were also to be found in the French *taille réelle,* which was a tax on the income of real property and laid by apportioning a fixed sum among the provinces and requiring from each its quota. The English land tax, established under William III, embodied a like provision.†

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* Chief-Justice Chase on more than one occasion judicially intimated that the definition of direct taxes by political economists can not be used satisfactorily for the purpose of construing the phrase in the Constitution of the United States. Thus, a tax on the circulation by banks of State bank notes was held not to be direct (Veazie *vs.* Fenno, 8 Wallace, 533–546), and so also of a tax on incomes of insurance companies (Pacific Insurance Company *vs.* Soule, 7 Wallace, 433).

† For further discussion of this subject, see paper by Prof. Charles F. Dunbar, contributed to The Journal of Economics, for July, 1889, and entitled The Direct Tax of 1861.

Be this as it may, the distribution of property (wealth) among the people of the American States at the time of the adoption of the Federal Constitution, as shown by the debates in the Constitutional Convention, was, very curiously, such that an apportionment of taxes according to population and representation was not inequitable. When the subject was under discussion, Roger Sherman, of Connecticut, said he "thought the number of people alone the best rule for measuring wealth as well as representation" (Elliot's Debates, v, 297). Mr. Gorham, of Massachusetts, "supported the propriety of establishing numbers as the rule. He said that in Massachusetts estimates had been taken in the different towns, and that persons had been curious enough to compare these estimates with the respective numbers of people, and it had been found, even including Boston, that the most exact proportions prevailed between numbers and property" (ibid., 300). Mr. Wilson, a leading member from Pennsylvania, said that, "taking the same number of people in the aggregate in the western settlements of Pennsylvania and in the city of Philadelphia, he believed there would be little difference in their wealth and ability to contribute to the public wants" (ibid., 301). Dr. Johnson, of Connecticut, "thought that wealth and population were the true, equitable rules of representation; but he conceived that these two principles resolved themselves into one, population being the best measure of wealth" (ibid., 303). And when the vote came to be taken in the Federal Convention on the proposition that direct taxation ought to be proportioned to representation, it passed without opposition (ibid., 302).

In the five occasions—1798, 1813, 1815, 1816, and 1861—in which the Federal Government has established a general system of direct taxation, there has been no essential and radical difference of opinion in respect to the methods and instrumentalities by which the provisions of the enactments could be made effective for the purpose of raising revenue. The amount of money desirable to raise was first determined. Then the population of each State was taken, according to the latest preceding census, and the proportion of tax proceeds respectively due was calculated.* A statute was then passed declaring that each State should pay to the Federal Treasury so much money, according to their ascertained proportionate liability of the aggregate amount which the entire Union of the States was required to raise. In each of the first four cases of such a system of taxation the several States were empowered to assume or assess in their own way the sums for which they were severally assessed and liable to pay into the national Treasury. In the case, however, of the levy in 1861, eleven States openly in insurrection against the Federal Government, one loyal State, and one Territory (Utah) refused or neglected to pay their assessment; whereupon a law was passed by Congress authorizing the appointment of special officials, whose duty it was to go into such States as soon as it was practicable and levy the proper assessments, seizing and selling real property whenever it became necessary to enforce payments of the amount required. And these provisions of law were enforced by threat or action to such an extent that about $2,800,100 were collected up to 1870, out of an aggregate quota of $5,153,891 due from all the States that adopted ordinances of secession; the total amount assessed on all the States having been $20,000,000.

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* Up to and including the direct tax of 1861, its imposition was scrupulously made in accordance with the understanding of the framers of the Constitution. Thus, the ratio of the State of New York in 1861 was returned at $2,602,918\frac{2}{3}$.

The confusion attendant on the settlement after the war of the unpaid liabilities of the impoverished insurrectionary States to the Federal Government, on account of the direct tax of 1861, finds further illustration in the circumstance, that the Comptroller of the United States Treasury decided in 1883 that the sum of $35,555, appropriated by an act of Congress to refund to the State of Georgia money expended by it in 1777, or one hundred and six years previously, for the common defense in the War for Independence, should be paid to the Treasurer of the United States, "to the credit of Georgia on account of direct taxes charged against the State." The Supreme Court of the United States also decided in 1887 (United States *vs.* Louisiana, 37, 123) that the direct-tax law in 1861 did not create any liability on the part of a State to pay the tax; and that the apportionment merely designated the amount to be levied upon the property of individuals in the several States, without any liability attaching to the State in its political and corporate character. "This decision finally left the unpaid quota of the direct tax of 1861 in precisely the same position as any other tax assessed upon individuals, which the United States has been unable or has neglected to collect in full." (Dunbar, Direct Tax of 1861, Quarterly Journal of Economics, July, 1889.)

At the time when it was proposed to enforce the tax on defaulting States by the seizure and sale of land, a doubt was expressed whether the tax in question was, in its essence, "a tax on the land and all the various estates into which the fee may have been divided, or was a tax on the owner of the land and levied on the interest of the owner in it, and on no other subordinate or incorporeal interest. But no tax was ever collected or any land sold under the act of seizure and sale." (Hillard, Law of Taxation.)

But, apart from a unison of opinion as to the methods by which a direct tax should be levied and collected under the Federal Government, the determination of what is a *direct* tax has not been an easy matter; and the question came up for solution before the United States Supreme Court shortly after the adoption of the Constitution, or in 1794, in a case that has become historic in the annals of American jurisprudence.

Congress having imposed a tax on pleasure carriages—or chariots, as they were then termed—its collection was resisted by one Hylton, of Virginia, on the ground that such a tax was a direct tax, and had not been apportioned among the States, as required by the Constitution. The court held that the tax in question was to be considered as a tax on the expenses of living and not a direct tax within the meaning of the Constitution, as the evils which would attend its apportionment according to population would be so great "that the Constitution could not have intended that an apportionment should be made." "The Constitution," said the Court, "evidently contemplated no taxes as direct taxes, but such as Congress could lay in proportion to the census. A tax on carriages can not be laid by the rule of apportionment without very great inequality and injustice. Suppose two States, equal in census, to pay eighty thousand dollars each, by a tax on carriages of eight dollars on every carriage, and in one State there are one hundred carriages and in the other one thousand. A, in one State, would pay for his carriage eight dollars; but B, in the other State, would pay for his carriage eighty dollars." (Opinion by Justice Chase, 3 Dall., 171.)

These, and other decisions of the United States Supreme Court, have accordingly been regarded as affirming, that within the meaning of the Constitution of the United States there are only two forms of taxation that can be considered as *direct*—namely, a capitation or poll tax, simply, and without regard to property, profession, or any other circumstance, and a tax on land; and that no other taxes can be regarded as direct by the Federal authorities. It is also worthy of note that since the decision in the carriage case in 1796, Congress, in the few instances in which it has imposed a tax which it recognized as direct, has never made it applicable to any objects other than real estate and slaves.

The following additional memoranda are pertinent to this discussion: While the carriage case was pending before the United States Supreme Court in 1796, Mr. Madison, who participated in the convention that framed the Constitution, wrote to the effect that the action of Congress in imposing this tax was constitutional, but that he doubted whether the court would so regard it. Hamilton, who appeared as one of the counsel for the United States in this case, also left behind him a legal brief in which he says: "What is the distinction between *direct* and *indirect* taxes?

It is a matter of regret that terms so uncertain and vague on so important a point are to be found in the Constitution. We shall seek in vain for any antecedent settled legal meaning to the respective terms. There is none. We shall be as much at a loss to find any disposition of either which can satisfactorily determine the point." In his argument on behalf of the Government in the carriage case, Hamilton, however, mentioned such taxes which should be considered as direct; namely, direct capitation taxes, taxes on land and buildings, and general assessment. (See his brief in the case referred to.) And in rendering the decision in the income-tax case of Springer *vs.* United States, Justice Swayne also added to our historical information on this subject by remarking, that "the question of what is a direct tax is one exclusively of American jurisprudence," which is the same thing as saying that the system of American taxation is so peculiar, that the question involved has never been made a subject of legal controversy and discussion under any other, or foreign system of taxation.

This statement of Judge Swayne is one of a number of illustrations that will confront the student of the existing American system of taxation—if, indeed, it is worthy of being called a system—showing how the makers and administrators of tax laws in the United States have drifted, as it were, into uses and practices which long usage has made to appear almost as of self-evident validity, but which find no precedent in the experience or systems of other countries, and no solid foundation in any correct economic philosophy.*

There were also two reasons and two points of view in the Hylton case on which the judgment of the court might have been predicated. One was that Hylton possessed one hundred and twenty-five carriages, which warranted the inference that they were hackney carriages, kept and used for hire, and that the tax levied on each carriage ultimately fell on the consumer and not on the owner (Hylton) himself; or, in other words, the tax in question was a tax on transportation, and, as such, capable of transference to the person carried, and therefore, when imposed on the carrier, was an indirect and not a direct tax. Another point is, that a tax on carriages has not the compulsory element which pertains to all direct taxes, as their ownership and use are optional, which is the special characteristic of all indirect taxes.

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* Since the statement of Judge Swayne (above referred to) was made, a decision has been rendered by the Privy Council of Great Britain, in which the recognition of direct taxation and its method of incidence by British jurisprudence is taken for granted; for in concurrence with a decision rendered by the full bench of judges concerning an opinion of one of their members, wherein he says, in speaking of a point that had been raised, that a tax must be general in order to be a direct tax, they reject that view, inasmuch as it "would deny the character of a direct tax to the income tax of this country—Great Britain—which is always spoken of as such, and is generally looked upon as a direct tax of the most obvious kind; and it would run counter to the common understanding of men on this subject, which is one main clew to the meaning of the Legislature."

Substantially the same question involved in the carriage case came up again (in 1874) before the same court (Springer *vs.* United States, 12 Otto, 102 U. S. Reports, p. 856), when a citizen of Illinois resisted the payment of a national income tax on the ground that such a tax was a direct tax; and not being levied in the manner prescribed by the Constitution, was not legal and valid. From an economic point of view such a tax, as has been before shown, is and always has been regarded as a direct tax; and on the hearing the plaintiff adduced in support of his position the testimony, as found in their writings, of almost every acknowledged authority on political economy or finance in the English language — Adam Smith, Ricardo, Mill, Wayland, Brande, Say, Perry, as well as the Encyclopædia Britannica and almost every other cyclopædia or dictionary of English or American origin.* The court, however, held as before, that under the definition of a direct tax, as expressed in the Constitution, the income tax was not direct but indirect, and accordingly that its imposition was not unconstitutional. The following was the exact language of the Court:

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* In all the debates in the British Parliament it is doubtful if any British statesman can be named who has ever spoken of an income tax as other than a direct tax. The same may be also affirmed of French authors and statesmen. The following citations of the opinions of various recognized authorities are illustrative:

"The taxes which it is intended should fall indifferently upon every species of revenue are capitation taxes." (Adam Smith.)

James Mill, under the title of "*Direct* taxes, which are designed to fall upon all sources of *income*," says, "Assessed taxes, poll taxes, and *income taxes* are of this description." (Elements of Political Economy, p. 267.)

J. R. McCulloch divides his work on taxation into two parts; Part I, on direct taxes, and Part II, on indirect taxes, and under the head of "Direct Taxes" he treats of "taxes on property and *income*."

Dr. Lieber, referring to the different modes of levying taxes, says: "The first way is direct—to determine from the statement of the parties concerned, or from official information, the net *income* of persons. This kind of taxes are called direct." (Encyclopædia Americana.)

"Taxes are either direct or indirect. A direct tax is one which is demanded from the very persons who it is intended or desired should pay it. *Direct* taxes are either on *income* or expenditure. . . . Most taxes on expenditure are direct, being imposed not on the producer or seller of an article, but immediately on the consumer. . . . The window tax is a direct tax on expenditure, so are taxes on horses and carriages." (John Stuart Mill, Political Economy, vol. ii.)

When Sir Robert Peel brought forward his plan for an income tax in 1842, he said: "*Indirect* taxation has reached its limits, and can no longer be relied on. My plan is this, to levy an income tax," etc. (Parliamentary Debates, lvi, 428; Ann. Reg., 1842, 72, 73.) And Lord John Russell said in reply: "To resort to the desperate measure of an income tax in such circumstances is nothing less than to proclaim to the world that your resources are exhausted, that indirect taxation has reached its limits," etc. (Parliamentary Debates, lvii, 86, 147; Ann. Reg, 1842, 77, 79.)

"Our conclusions are that direct taxes within the meaning of the Constitution are only capitation taxes, as expressed in that instrument, and taxes on real estate; and that the tax of which the plaintiff complains" (i. e., a direct tax) "is within the category of an excise or duty."

Whether warranted or not, the drift of public opinion in the United States has been, that the decision of its Supreme Court in the Springer case in 1874, and, to a certain extent, in all previous cases touching the constitutionality of an income tax, was made under the pressure of an apparent political necessity. Had the decision been to the effect that the income tax was a direct tax, and any method of levying it other than that prescribed by the Constitution—i. e., according to population—was unconstitutional, the Government would have been forever practically deprived of an effective instrumentality for raising revenue which might be most desirable in cases of emergency. Immense sums which had been paid under protest as income taxes would also have been pressed for repayment in case the decision had been otherwise, to the serious embarrassment of the national Treasury.

In harmony with the above decisions, the United States Supreme Court has decided that neither taxes on distilled spirits (United States *vs.* Singer, 15 Wall., 111), nor succession duties on the devolution of title to real estate (Scholey *vs.* Rew, 23 Wall., 331), nor taxes on the notes of State banks (Veazie Bank *vs.* Fenno, 8 Wall., 533), nor taxes on the receipts of insurance companies from premiums and assessments (Insurance Company *vs.* Soule, 7 Wall., 433) are direct taxes; but that all such taxes are imposts and excises, and subject, therefore, to the requirement as to uniformity, but not subject to the requirement of apportionment.

Important, interesting, and instructive from a constitutional, legal, and economic point of view, as was the experience of the United States in respect to direct taxation, prior to 1894, the sequel of events and experience in respect to this question and its involved problems has been no less important and worthy of narration.

By an enactment of Congress, August 18, 1894, establishing an income tax for the United States, a tax of *two* per cent was imposed on the gains, profits, and income of persons derived from any kind of property, including rent and the growth and produce of lands, and profits made upon the sale of land if purchased within two years. Every element that could make real or personal property a source of value to an owner was taxed. An excise duty was also imposed upon income derived from any profession, trade, employment, or avocation. The tax upon persons generally was not upon their entire income, but on the excess over and above the sum of $4,000. All persons having incomes of $4,000 or under were exempt. The whole burden of the tax, it was estimated, would fall on less than two per cent of the population of the country. That the Government practically conceded that such a feature of the act was pre-eminently class legislation is evident from the following extract from a statement made in a brief by the Attorney General of the United States: "Congress," he says, "has adopted as the *minimum* income for the purpose of taxation the limit of $4,000. This limit may be said to divide the *upper* from the *lower middle class,* financially speaking, in the larger cities, or to divide the *middle class* from the wealthy in the country districts." (*Opening argument by William D. Guthrie, in support of the contention that the income-tax law of 1894 was unconstitutional.*)

As might have been expected, the provisions of this enactment, which could not be fairly considered pertinent and relevant to a just and equitable system of income taxation, occasioned much of dissatisfaction among business men and the financial authorities of the country generally; and measures were at once initiated to test before the proper legal tribunals—i. e., the courts of the United States—the constitutionality of the statute. The most important and immediate representatives of this action were the Farmers' Loan and Trust Company and the Continental Trust Company, of New York—two of the largest trust companies in the United States. It is also worthy of note in this connection that the above-named companies, before taking any steps to test the validity of the act in question, complied with all its provisions; no collector of internal revenue or any public officer of the United States having been made a party, or any injunction sought from the courts, to restrain the collection of the tax.

The basis of action of the above-named parties, as represented by some of the most eminent members of the legal profession in the country,* was substantially as follows: Each of them, and a large number of other like organizations—insurance companies, savings banks, and trusts—hold as investments of capital stock, earnings, and profits, and as trustees for minors, widows, individuals, copartnerships, and corporations too numerous to mention, resident in the United States and elsewhere, large amounts of real estate, situated in the various States of the Federal Union, and amounting in aggregate value to hundreds of millions of dollars. The rents and income of this real estate, also annually amounting in the aggregate to large sums, are collected and received by the above-mentioned organizations, and held by them in their various fiduciary capacities.

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* Messrs. Joseph Choate, Clarence A. Seward, William D. Guthrie, Benjamin H. Bristow, David Wilcox, and Charles Steele. For the United States, James C. Carter and Richard Olney, the Attorney General.

The first point of importance under such a state of affairs to which attention is asked is, that taxes levied or laid by the Federal Government are recognized and admitted (in virtue of repeated decisions and assumptions of the United States Supreme Court) to be typical forms of *direct* taxation, and as such under a clear and carefully worded provision of the Federal Constitution must be apportioned among the several States according to their respective population.* On this point, therefore, there could obviously be no legal contention.

It is now well recognized that this provision of the Constitution, after full discussion and careful wording on the part of its framers, was adopted in order to protect to the States, which in entering into union were surrendering to the prospective Federal Government so many sources of income, the power of direct taxation, and so preclude a combination of States from exacting tribute from other States.†

The next point of contention in order of importance in the case as presented to the United States Supreme Court was; did the provisions of the income-tax act of 1894, imposing a tax of two per cent upon the gains, profits, and income derived from all kinds of property—including rent and the gains and profits accruing from the growth, profits, or sale of land—involve and create a tax which must necessarily be deemed a direct tax on real estate (land), and which not being apportioned (levied) according to the provision of the Constitution render the entire act imposing an income tax unconstitutional and void?

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* "Representatives and direct taxes shall be apportioned among the several States which may be included within this Union according to their respective numbers."—*Constitution of the United States, Article I, section 2.*

† "The founders anticipated that the expenditures of the States, their counties, cities, and towns, would chiefly be met by direct taxation on accumulated property, while they expected that those of the Federal Government would be for the most part by indirect taxes; and in order that the power of direct taxation of the General Government should not be exercised except on necessity, and when the necessity arose should be so exercised as to leave the States at liberty to discharge their respective obligations and should not be so exercised unfairly and discriminatingly as to particular States or otherwise by a mere majority vote, possibly of those whose constituents were intentionally not subjected to any part of the burden, this qualified grant was made. Those who made it knew that the power to tax involved the power to destroy, and that the only security against the abuse of this power is found in the structure of the Government itself. In imposing a tax the Legislature acts upon its constituents. This is in general a sufficient security against erroneous and oppressive taxation, and they retained this security by providing that direct taxation and representation in the lower House of Congress should be adjusted on the same measure."—*Chief-Justice Fuller.*

The precise or original question involved, it was admitted, was one on which the Federal Government had really never been heard,* and was first brought before the United States Supreme Court for a hearing and adjudication in April, 1895. On that occasion the court held that the provisions of the act of August 15, 1895, were unconstitutional, so far "as they purport to impose a tax on the rent or income of real estate." It was, however, equally divided on the following questions, and expressed no opinion in regard to them:

(1) Whether the void provisions invalidated the whole act; (2) whether, as to the income from personal property as such, the act is unconstitutional as levying direct taxes; (3) whether any part of the tax, if not considered as a direct tax, is invalid for want of uniformity.

The court, early in its history, adopted the practice of requiring, if practicable, constitutional questions to be heard by a full court, in order that the judgment in such cases might, if possible, be the decision of the majority of the whole court. And as the court was not full, at the first hearing in April, and as four judges did not concur in the opinion then rendered, a rehearing was granted by the court in the month following (May 6th, 7th, 8th); in the announcement of which the Chief Justice remarked that "the importance to the Government of the new views of its taxing power can hardly be exaggerated."

In advocating the constitutionality and rightfulness of the provisions of the income tax of 1894, the then United States Attorney General, Hon. Richard Olney, on behalf of the Government, made in part the following argument:

"What is this" (contested) "tax in its true value and essence? It is an assessment upon the taxpayer on account of his money-spending power as shown by his revenue for the year preceding the assessment. It is not a property tax in any sense or of any sort. Yet this is the sort of tax which is called a tax on real estate for no other reason than that last year's rents form a part of the yardstick by which this year's money-spending capacity is measured! A greater error, I submit, could not easily be justified. My Lord Coke is quoted to the effect that a grant in fee of the profits of land passes the land itself. Other citations are always interesting, and state a rule of law which is indisputable and of universal acceptance. But what is their relevancy to the case in hand? They relate to grants taking effect in future—to grants taking effect from the date or delivery of the deed, or from the probate of the devise, and carrying all after-accruing rents as a matter of course. But what this case is concerned with is rents that have not only become due, but have actually been received by the landlord. Does any one pretend that rents thus received would pass by a grant of the estate that has yielded them? Of course not, and why? Because, by falling due and being collected, they have become severed from the realty, and have become personal property—money in the landlord's pocket, like any other money. Nothing is gained, however, by belittling or evading an argument, and I have no intention of doing either. The strength of the plaintiff's claim is in the proposition that the value of land is in its use; that rents are the pecuniary equivalent of the use, and that, therefore, to tax rents is in substance and effect to tax the land itself. This is what may be called a fetching proposition. How much truth is there in it, and how much of applicability to the present case? There is this much of truth in it: that a tax upon rents to become due—to accrue in the future—may well be deemed a tax on the estate itself. Such accruing rents are like growing crops, an inseparable part of the land, and whatever is a charge upon them is necessarily a charge upon the land. But the proposition stated has no application whatever to the present case, because the tax it has to do with is a tax in respect to rents already due and collected, and in all probability either spent or transformed into other tangible property. How can a tax in respect to such rents be said to be a tax upon the real estate producing them? When they become due and are paid, just as when crops are harvested; when either process is complete, a new and distinct item of property comes into existence, and the landlord's property realizes a corresponding accretion."

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* None of the previous decisions of the court "discussed the question whether a tax on the income of personalty is equivalent to a tax on that personalty; but all held real estate liable to direct taxation only so as to sustain a tax on the income of realty on the ground of being an excise or duty."—*Chief-Justice Fuller.*

In rejoinder the counsel for the appellants maintained that under the income-tax enactment in question (i. e., of August 28, 1894) a tax was imposed upon income "derived not merely from business, but also expressly upon that derived from property, and therefore directly upon the property producing the income, whether real or personal." Notably is this the case with a tax upon "rents" and the "growth and produce of land." It taxes every element of value of the land which the owner can realize from third parties. It must be clear that a tax upon what gives the land value is a tax upon the land itself. In the words of Hamilton, "What in fact is property but a fiction without the beneficial use of it?" In many cases, indeed, the income or annuity is the property itself. As one of the justices said in the

Hylton case, "Land, independently of its produce, is of no value." It scarcely needs argument to establish that anything which affects every element that gives an article its value, in the eye of the law, affects directly the article itself. In illustration of this many decisions, mainly of the United States Supreme Court, were cited, of which the following are examples:

In Brown *vs.* Maryland, 12 Wheaton, it was held by the United States Court that a tax on the occupation of an importer is the same as a tax on imports, and was therefore void.

In Weston *vs.* Charleston, 2 Peters, it was held that a tax upon the income of United States securities was a tax upon the securities themselves, and equally inadmissible.

In Almy *vs.* California, 24 Howard, it was held that a duty on a bill of lading was the same thing as a duty on the article which it represents.

In Cook *vs.* Pennsylvania, 97 United States, it was held that a tax upon the amount of sales of goods made by an auctioneer was a tax upon the goods sold.

In Railroad Company *vs.* Jackson, 7 Wallace, it was held that a tax upon the interest payable upon bonds was a tax not upon the debtor, but upon the security, the bonds.

In Philadelphia Steamship Company *vs.* Pennsylvania, 122 United States, it was held that a tax upon the income received from interstate commerce was a tax upon the commerce itself, and equally unauthorized.

"If a man seized of lands in fee by his deed granteth to another the profit of those lands to have and to hold to him and his heires, the whole land itselfe doth passe; *for what is the land but the profits thereon?*" (Coke upon Littleton, the accepted rule of law in every court in English Christendom.)

A devise of the interest or of the rents and profits is a devise of the thing itself out of which that interest on those rents and profits may issue (Patterson *vs.* Ellis, 11 Wendal).

It seems clear, therefore, that the weight of judicial opinion as expressed in the judgments of the highest courts, both in the United States and England, was to the effect that the tax imposed under the United States act of August, 1894, on the income from the use, profits, and sales of land was a direct tax, and, not being apportioned in accordance with a strict provision of the Federal Constitution in respect to the levy and collection of said tax, was necessarily unconstitutional and void.*

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* The following rejoinder by one of the counsel for the applicants (Mr. Choate) to a portion of the argument made by the Attorney General (Mr. Olney), and before cited, is pertinent and instructive, as respects the much-vexed question as to the *situs* of property for the purpose of tax administration:

"The Attorney General says, 'When a man has got the money in his pocket it is no

Apart from the leading element in this celebrated case, and on which the final decision of the court was mainly based, was that provisions in the act of 1894 establishing an income tax, being in the nature of direct taxation, and the same being not assessed in accordance with the requirements of the Federal Constitution, were void in effect. The constitutionality of the entire act was also questioned on the ground that it violated the constitutional requirements that "all duties, imposts, and excises shall be uniform throughout the United States." Thus, for example, it taxed the income of certain companies and associations, "no matter how created or organized," at a higher rate than the income of individuals and partnerships derived from precisely similar property; and denied to individuals deriving their income from shares in certain corporations and associations the benefit of the exemption of $4,000 granted to all other persons interested in similar property and business, and the like. These features of the act of 1894, although constituting most important and instructive contributions to the general subject of "taxation," are not, however, so pertinent to the immediate subject under consideration as to require at present any extended discussion.

CONCLUSION.—As the result of the hearing and discussions involving the constitutionality of the income-tax statute of August 28, 1894, the United States Supreme Court, a majority of its members concurring, gave judgment as follows:

1. WE ADHERE TO THE OPINION ALREADY ANNOUNCED, THAT TAXES ON REAL ESTATE BEING INDISPUTABLY DIRECT TAXES, TAXES ON THE RENTS OR INCOME OF REAL ESTATE ARE EQUALLY DIRECT TAXES.

2. WE ARE OF THE OPINION THAT TAXES ON PERSONAL PROPERTY, OR ON THE INCOME OF PERSONAL PROPERTY, ARE LIKEWISE DIRECT TAXES.

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longer rent.' One thing I would say about that is, that if you are going after rent as money, the tax is on personal property, and should be apportioned. But the answer is that the tax does not go after the rent as money in the taxpayer's pocket. The act of 1894 (section 27) specifies the rents as a cardinal part and element of this income return, and every man who goes up to make return has to state under oath what rent he got last year. This fiction—this difference between the name and the thing, between the substance and the shadow, urged by the Attorney General—is that, though you can not tax rent, you can tax the money in the owner's pocket received from rent. If there is one factitious argument, one pretense of a reason, one attempt to make a distinction without a difference that this court has uniformly stamped upon with all its might, it is just that. The court has repeatedly decided that such an argument is wholly unsound. What did the court mean in Brown *vs.* Maryland, when it held that a tax on the occupation of an importer is the same as a tax on imports and is therefore void? It is the source, the substance, that the act strikes at, that the court always looks to, and always has looked to, in any form and case that has ever come before it until now."

3. THE TAX IMPOSED BY SECTIONS TWENTY-SEVEN TO THIRTY-SEVEN, INCLUSIVE, OF THE ACT OF 1894, SO FAR AS IT FALLS ON THE INCOME OF REAL ESTATE AND OF PERSONAL PROPERTY, BEING A DIRECT TAX WITHIN THE MEANING OF THE CONSTITUTION, IS THEREFORE UNCONSTITUTIONAL AND VOID, BECAUSE NOT APPORTIONED ACCORDING TO REPRESENTATION. ALL THOSE SECTIONS, CONSTITUTING ONE ENTIRE SCHEME OF TAXATION, ARE NECESSARILY INVALID.

A brief word more is desirable to complete the record of the curious and instructive experience of the United States in respect to the enactment and administration of direct taxation.

Theoretically an almost ideal system, especially if made universal in its incidence and exclusive of all indirect taxes, its application under a dual form of government, such as exists in the United States, with a practical denial of resort to arbitrary action in collection, such as exists in all despotic governments, and an accepted rule that neither the "nation" nor the forty-five "States" shall tax an instrumentality of the other, will be necessarily most perplexing. These and other like circumstances, more especially the inequalities and inefficiencies contingent on the act of 1861, therefore, render it almost certain that direct taxation will not hereafter be resorted to by the Federal Government until all other means of relief for its treasury have been exhausted. With the decision of the United States Supreme Court in 1896 against the taxation of land incomes remaining unimpaired, as it probably will be unless the Federal Constitution is practically reconstructed, the enactment by Congress of another income tax which will not reach more than half the incomes designed to be reached, will probably not be attempted. When it is also considered that it will be an impossibility to separate the part of incomes of great corporations which they derive from real estate, when they necessarily use real estate in common with other property in order to derive any income, the enormous expense and interminable litigation contingent on any attempt on the part of the Government to enforce such a law will be almost beyond estimate.

NOTE.—In order to render more complete the discussion of the nature and historical experience of the "poll tax," previously given in Chapter VIII, pages 165–175, Popular Science Monthly, No. 2, vol. lx, attention is here asked to a statutory and legal action on the part of one of the States of the Federal Union that has hitherto largely escaped public attention, and which probably finds no exact precedent in history.

The antagonism between the white and colored races of the Southern States, mainly contingent on the former toleration of slavery, still continues to a large degree, although both races, by amendments to the Federal Constitution, have been placed on terms of full legal right and equality. In no one respect does this antagonism more persistently manifest itself, than in opposition on the part of the white citizen voters to the exercise of free and concurrent suffrage by the negro citizens. Yet, in view of the restraints imposed by the Federal Constitution in respect to political or legal discriminations against the negro race, any change in the way of relief from the situation by State enactment has been regarded as impracticable. A recent constitutional convention of the State of Mississippi seems, however, to have at last most ingeniously solved this difficult political problem, by enacting that every citizen (white or black) of established age shall pay a poll tax, the nonpayment of which shall exclude him from voting; and the collection of the tax out of exempt or nontaxable property—i. e., the possessions mainly of the poorer classes—was also denied. The intent of this provision was therefore manifestly not to raise revenue, but to exclude negroes from voting by reason of nonpayment of the poll tax; and by a like covert purpose the commission of a list of petty crimes which white men do not generally commit, such as thievery, arson, and obtaining money under false pretenses, was also made a disqualification of voting; while robbery, murder, and other robust crimes which are practiced chiefly by white men were not included.

"Within the field of permissible action under the limitations of the Federal Constitution, the Mississippi convention swept the circle of expedients to obstruct the exercise of the franchise for the negro race."—*Ratliff vs. Beale, Mississippi Reports.*

In the preface to the works of Jean Rey, the philosopher who nearly three hundred years ago first suggested the cause of the increase in weight of lead and tin when burned, M. Edouard Grimaux notices some of the theories that have been put forth on the subject. Boyle explained the increase by supposing that corpuscles of fire, passing through the walls of the vessel in which the calcination took place, became fixed in the metal. This theory was accepted by Stomberg, Lemery, and Nicolas Lefèvre, and was formulated by Lemery: "The pores of the lead are so disposed that the corpuscles of the fire insinuate themselves among them; they remain fastened and agglutinated in the pliant and intricate parts of the metal without being able to escape from them, and add to its weight." Father Chérubin, of Orleans, refuted this explanation by showing that glass was not thus permeable; while Boerhaave, and afterward Boulduc, held that there was no increase of weight in the calcination of metals. Bierne, in 1753, supposed that some rich and sulphurous acid coming from the flame became fixed in the metal. Lavoisier declared the true cause—the fixation in the metal of a part of the air—in 1774, and a little while afterward, in 1775, Bayen called attention in the *Journal de Physique* to the existence of Jean Rey's Essays.

THE THYROID GLAND IN MEDICINE.*

By PEARCE BAILEY, M.D.

IN the past few years a remedy has been discovered for certain conditions hitherto regarded as incurable, which is certain in its action, and which for the beneficence of its results stands unrivaled in therapeutics; and, since from the infrequency of the diseases which it cures but little is known of this agent outside of the medical profession, it has appeared to me that a short description of the development and application of the thyroid treatment, one of modern medicine's greatest achievements, should prove of interest to any one who cares to observe the advances of medical science. The task is the more pleasant from the fact that the use in medicine of the thyroid gland of animals is a logical conclusion from adequate premises, and because the thyroid forms one of the few medicinal agents in our possession which are not given on purely empirical grounds.

It is a generally familiar fact that the majority of drugs are prescribed because medical history records that, for some unknown reason, they have proved effectual in the diseases in which they are administered, though why they should do so remains unexplained. In certain conditions mercury has a specific action, the nature of which is absolutely unknown. Quinine had cured the Countess Chinchon (and hence the name *cinchona*) of her ague centuries before a clever Frenchman discovered that malaria resulted from the activity in the blood of a vegetable parasite on which Peruvian bark exerts a restraining influence.

So it is with most of the remedies which the physician employs: he uses them because experience has shown that they will do good in the conditions in which he prescribes them, although he has not learned why. But in the use of animal thyroid the physician knows that he has a sovereign remedy, and he also knows the reasons for the brilliant results of its proper application. To appreciate the philosophy of the action of this agent requires the understanding of a few facts in anatomy and physiology which relate to what the thyroid gland is and to what it does.

In man the thyroid gland lies deep in the neck, in front and at the sides of the windpipe, and is covered by skin and muscle; its deep situation renders it difficult to be felt in the living subject. The thyroid belongs to the class of glands known as ductless—that is, there is no canal or duct by which the secretions of the gland are carried out. Its function, like the function of the other ductless glands (the spleen, the thymus, and the adrenal bodies), is but imperfectly understood. I shall limit myself to saying that the presence of the normal thyroid gland is necessary for health, and that it is supposed that the secretion of the gland, which enters the blood-current directly, either neutralizes some poison which, from the ordinary processes of life, is circulating in the blood, or furnishes to the blood some substance which is necessary to it. When from any cause this function of the gland is interfered with, very characteristic symptoms result. It is only within recent years that it has been recognized that impairment of thyroid function can and does cause a definite group of symptoms which constitute a disease. These symptoms may occur when a tumor develops in the gland, and will be intensified if, when the tumor is removed, much of the gland substance is destroyed.

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* Read at Saratoga, September 2, 1896, before the American Social Science Association.

But the most important disease of the gland itself, which is insidious, chronic, and progressive, is myxœdema. This affection is a chronic inflammation of the thyroid gland, by which the secreting structure is gradually destroyed, and which consequently deprives the patient of the good services which are rendered by a normal gland. In many respects myxœdema resembles Bright's disease, and it was some time after the first description of it by Sir William Gull before it became established that the affection depended upon the impairment of function of the thyroid gland, and not upon disease of the kidney. The most prominent symptom of the disease, and the one from which the name is in part derived, is an œdema or swelling, which, unlike the œdema of Bright's disease, does not pit on pressure. This œdema is most prominent in the face, and it is there that it begins, although later in the disease it may extend to the hands and feet, and thereby increase the general weight of the body. The lips are thickened, the nose becomes large and flat, and the eyelids are swollen. Owing to the swelling of the tongue and throat, the character of the voice may be changed. The skin is dry, rough, and peculiarly pale; the hair falls out—a symptom particularly noticeable in the eyebrows—the teeth become poor and the nails brittle. The pulse is slow, the heart is weak, and the temperature is almost always below the normal. Neuralgic pains are of common occurrence in myxœdematous patients, and cold weather is very disagreeable to them, probably on account of their low body temperature. The muscles are weak, especially those of the head and neck, and all muscular movements are slowly performed. The mind becomes dull and apathetic; there is usually developed irritability of temper. Hallucinations or perverted sense perceptions are not at all uncommon, and occasionally the affection terminates in insanity. These patients are peculiarly sensitive as to their own appearance and to the attention which it attracts, and consequently shun society; and for this reason partly, and partly because of their muscular weakness and subnormal temperature, they like nothing so well as staying quietly in the house. The onset of the disease is gradual and its progress is slow, ordinarily extending over a period of several years. It most frequently occurs in women of middle age. Altogether myxœdema, although not a direct menace to life, makes the victim of it very uncomfortable and unhappy.

The appearance of a person suffering from advanced myxœdema is so characteristic that when one has seen a case there is usually no difficulty in recognizing another. In the earlier stages, however, when the disease is beginning, its diagnosis may be difficult or temporarily impossible.

Myxœdema is not a common disease in this country, and until five years ago was regarded as incurable. But as physicians become more familiar with the condition, which after all has only been recognized for about twenty years, and more especially as the possibility of curing it becomes more widely known, it is altogether probable that we shall find the disease less rare than we have been led to suppose.

The series of experiments which led to the employment in this disease of the thyroid glands of animals resulted in discoveries so complete and definite that it became possible to predict that the thyroid treatment of myxœdema would be a success. Before Sir William Gull described the affection and claimed for it a place of its own among the list of distinct diseases, it had been regarded as a variety of Bright's disease. But to the trained eye the resemblance of myxœdema to Bright's disease was too superficial to be satisfying; and, furthermore, when these patients died their kidneys, which would have shown disease changes if they had been responsible for the symptoms observed in life, were found to be normal. So the first step forward in our knowledge of the disease was the establishment of the fact that the seat of the trouble was not in the kidneys; it was not discovered until later that it was in the thyroid gland. This discovery came about from several sources.

It was observed by physiologists that animals from which the thyroid gland had been removed developed a condition of œdema and stupidity; and several surgeons reported that patients from whom the thyroid gland had been removed by operation for various causes developed symptoms almost identical with those of the cases which had been regarded as examples of Bright's disease, but in whom the kidneys were found nearly normal.

This experimental evidence was amplified by the work of pathologists who, in their examination of all the organs of persons dead with myxœdema, found that there existed constant disease in the thyroid, so that it became established beyond doubt that these symptoms, which were so much like those of Bright's disease, were in reality due, not to the ordinary causes of Bright's disease, but to a chronic inflammation of the thyroid gland—a process which resulted in the diminution or loss of the function of the gland, and a consequent deprivation of the secretion which it was intended to supply.

The symptoms which ensued after extirpation of the thyroid gland, whether in man or in the lower animals, received the name of *cachexia thyreopriva*, or operative myxœdema; when the condition occurred independently of such operations—i. e., from primary disease in the gland—it was called myxœdema; but although the pathology of myxœdematous conditions thus became established, it was a long time before it became known how they could be cured; and again it was due to the ingenuity and observation of physiologists and surgeons that it eventually became possible for the physician to apply a form of treatment which has proved curative for myxœdematous conditions of whatever origin.

It occurred to physiologists that if another thyroid could be made to grow beneath the skin of an animal whose own gland had been removed, the new thyroid might assume the functions of the one which was gone; and surgeons conceived the same idea for patients from whom the thyroid had been removed at operation. This was accordingly tried: physiologists grafted sheep's glands in monkeys whose own thyroid they had removed experimentally; and surgeons put sheep's glands beneath the skin of patients who had been operated upon on account of thyroid disease. Although these procedures were only partially successful, they were the beginnings which led to the ultimate establishment of the thyroid treatment. The results of these graftings were beneficial for a time, but as the transplanted thyroid could not be made to accommodate itself to its new home, the effects soon wore away and the myxœdematous symptoms returned. The temporary benefit, however, was so pronounced that it was evident that the disease had in some way been influenced by the grafted thyroid. Since the gland at the time of its transplantation was full of its normal secretion, but could not be made to secrete further after grafting, it was inferred that the beneficial influence was solely due to the thyroid juice which the grafted gland contained. So it became evident that the successful treatment of myxœdematous conditions required an uninterrupted supply of thyroid secretion. It was not until 1891 that Dr. G. R. Murray drew this conclusion, and presented at a meeting of a medical society in England a woman with myxœdema whom he said be intended to treat by subcutaneous injections of the extract of the thyroid gland of the sheep. When about six months later he showed the same patient, improved in every way, the success of the treatment was established.

The success which followed this experiment was so immediate and complete, and was so speedily substantiated by physicians the world over, that thyroid therapy at once became the recognized means of treating myxœdema and allied conditions.

The results of the treatment are very striking; the œdema rapidly disappears, leaving the skin soft, smooth, and moist; the mental dullness gives way to cheerfulness and hope; strength is returned to the weakened muscles, and the patient becomes once more, to all appearances, a normal individual. A large number of cases of myxœdema have been recorded as cured by thyroid feeding, and these reports are usually accompanied with photographs of the patient as he appears before and after treatment, which present most striking contrasts. Through the courtesy of Dr. John Woodman, of New York, I am able to give the reproductions of the photographs (Figs. 1 and 2) of a case successfully treated by him. A common history of the early cases treated in this way is somewhat as follows: A woman has had myxœdema for years, and has been told by many physicians that her condition is incurable, and she is indifferent and skeptical as to the value of the treatment proposed for her. In a few months it is

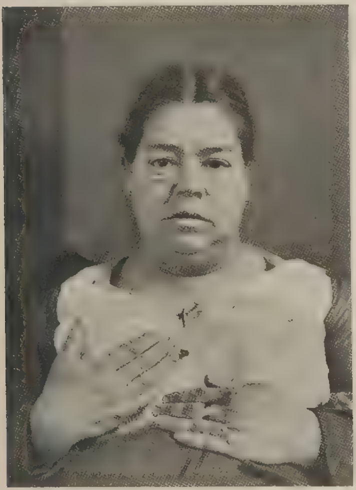

Fig. 1.—Myxœdema. Before treatment.

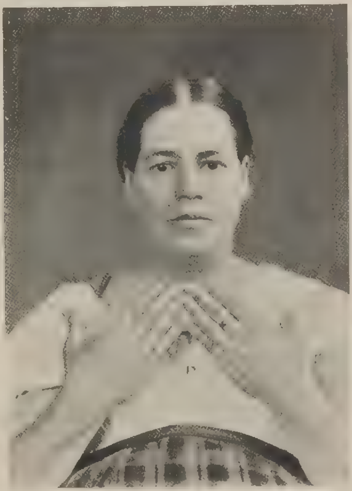

Fig. 2.—Same patient after treatment.

with difficulty that she can be recognized as the same person. The swollen, pallid, stupid face is gone, and in its place are red cheeks and the pleasant expression of a healthy woman. She can walk several miles a day, sleep well, has a good appetite, and enjoys life.

Such is the history of myxœdema and how it came to be treated by the thyroid gland of animals. Therapeutics can show no more brilliant results than these.

When myxœdema occurs in infancy or childhood it is called cretinism. The word "cretin" will recall to the minds of most of my readers visits to Switzerland or to the eastern parts of France, where these queer little dwarfs are so common. Goitre is also, curiously enough, frequent in these localities. But few are aware that we, here in America, possess cretins of our own. In the cretinous regions of Europe, where so many of the inhabitants are afflicted with the disease, it is called endemic or peculiar to the country. In America it occurs only occasionally, and not with any geographical regularity, and so such cretins are called sporadic. Now, sporadic cretinism with us is certainly a rare affection; but as the condition becomes more familiar to physicians, and as the inmates of our own idiot asylums are more carefully examined, it is possible that it will be found that cretinism, like myxœdema, is less rare than had been suspected.

The absence or disease of the thyroid gland produces much the same symptoms in the child as in the adult; the most striking difference is due to the fact that in the child development of the body and brain is interfered with, so that cretins are generally dwarfs, and the failure of mental development results in a condition closely allied to idiocy. These idiotic dwarfs are very repulsive to look at. They have large heads and necks and thick lips, through which protrudes the clumsy tongue. They have few or no teeth, and the swelling of the throat renders the voice indistinct. The nose is large and flat, and the swollen eyelids partly cover eyes which are frequently crossed. The limbs are swollen and often incapable of service; the skin which covers them is hard, rough, and thick. Cretins are always short, and may never grow taller than a normal child of two or three years. They never attain a high degree of intelligence, and most commonly are idiots with only the power to comprehend the simplest things of daily life, and with a vocabulary limited to a few words.

There are some differences between endemic and sporadic cretinism, and what follows applies only to sporadic cretins.

What has been said concerning the treatment of myxœdema by thyroid feeding may be repeated for sporadic cretinism. The changes which result from the thyroid treatment of cretins, owing to their stunted bodies and vacant minds, are even more astonishing than those described for myxœdema; for in cretins, not only do the œdema and other general symptoms disappear, but the dwarf begins to grow, and the idiot to show signs of intelligence. One patient who, at the beginning of treatment, was sixteen and a half years old and only thirty-three and a half inches in height, and in whom no growth had occurred in fourteen years, grew four and three quarters inches in six months; another, sixteen and a half years old and twenty-nine and a half inches tall at the beginning of treatment, increased six and a half inches in height in six months. Under treatment the teeth begin to grow, and the facial expression and the whole appearance of the patient are radically changed. The patients soon become more intelligent and appreciative of their surroundings, and many begin to talk and to understand what is said to them. How striking may be the improvement in the general appearance is shown by Figs. 3 and 4, which are reproductions of photographs of a little patient treated by Dr. J. C. Carson, superintendent of the Syracuse Institution for Feeble-minded Children.

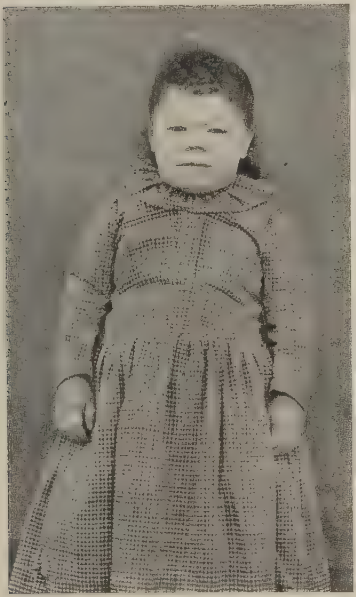

FIG. 3.—SPORADIC CRETINISM. Before treatment.

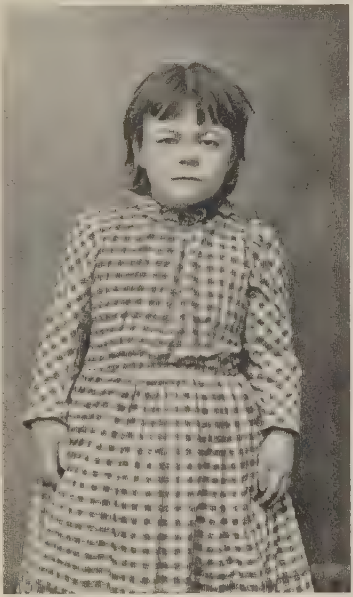

FIG. 4.—Same patient after treatment.

That the results will be permanent, and that these idiotic children will become, under the influence of the thyroid treatment, intelligent men and women, it is as yet impossible to say.

The occurrence, in the formative period of infancy and childhood, of a disease which attacks fundamentally nutrition, development, and growth, has much more disastrous effects than when its appearance is delayed until the organism has reached maturity.

And while it is possible that the removal of causes inhibitory to growth may result in a gradual return of developmental processes, the thyroid treatment of infantile myxœdema has in no case been carried out for a sufficient length of time to permit the assertion that such will be the case. In no case is treatment reported to have lasted more than three years, and in few cases is it said that the patient is in all respects cured; but from the fact that in nearly all of the cases treatment was not instituted until the child was several years of age and had developed but little or not at all for a considerable length of time, several years would be necessary, by the natural processes of development, for the complete re-establishment of normal growth.

Although data sufficient to justify positive assertions are lacking, it seems entirely in the range of possibility that if the treatment of sporadic cretinism were begun at the outset of the disease, before growth was seriously interfered with, it would permit the proper development of the child without myxœdematous symptoms as long as the thyroid was administered.

From the consideration of the history of myxœdematous conditions it will have been seen that all this treatment promised to do was to supply to the body the necessary substance which the thyroid gland was no longer able to produce. It never undertook to supply a new thyroid gland; and the disappearance of the symptoms of myxœdema under the thyroid treatment means that the necessary secretion is being artificially supplied, and not that the function of the gland has been restored.

Consequently, any one in whom the activity of the thyroid gland has been lost, whether it be by myxœdema, or operation which has induced the condition of cachexia thyreopriva, must continue the use of the thyroid glands of animals for the remainder of life. Dr. Murray's original case is still taking thyroid, and after five years remains well.

The therapeutic use of the thyroid has now been tried in many other conditions with varying success. From its efficacy in reducing the size of ordinary goiters it has to a great extent supplanted the knife in the treatment of that condition. Recent reports from Germany would seem to indicate that it exerts a beneficial influence upon the development of children who are physically or mentally backward, although they have none of the characteristic symptoms of cretinism. Its power to reduce excessive fat is becoming very widely known, and when properly used it certainly is a valuable agent for this purpose. In many diseases it may prove to be of service, though, aside from its use in myxœdematous conditions, exactly what place in the materia medica should be assigned to it, it is as yet impossible to say. The gland is obtained chiefly from the sheep, and is usually administered in the form of a dried powder or in tablets. Alarming symptoms may occur as a result of overdosage; such symptoms consist in too rapid loss of weight, or feeble heart action, or lowering of the temperature; they usually subside when the remedy is stopped. It should be remembered, however, that it is a mysterious and powerful agent, by no means destined for indiscriminate use.

In conclusion, it may be said that the introduction into medicine of the thyroid gland is a logical conclusion from adequate premises. It resulted from scientific experimental and chemical study by trained and skillful workers, and it has nothing in common with the largely advertised "organic extracts," which are false in theory and worthless in practice.

Animal thyroid is by no means a cure-all, and even in myxœdematous conditions which have existed for many years it may be unable to repair the ravages of the disease; but it has shown itself, when appropriately applied, to be among the most unfailing therapeutic agents in our possession.

THE DESPOTISM OF DEMOCRACY.

By FRANKLIN SMITH.

"WHATEVER crushes individuality," says John Stuart Mill, describing the essential feature of all political governments, "is despotism, by whatever name it be called, and whether it professes to enforce the will of God or the injunctions of men." * Be the government autocratic, aristocratic, or democratic, the power it wields in restraint of natural rights, or of equal freedom, puts it under the ban. Decked though it be with motives worthy of the noblest philanthropy, aim though it may to fill the world with saints, it is vitiated by the love of power and by the check it puts upon the natural growth of character. It would make all men, not like the diversity of Nature, but like the figures of Egyptian art. If democracy as well as autocracy and aristocracy has sought to accomplish this task; if the former as well as the latter, in the pursuit of an enterprise that has always ended and must inevitably end in disaster, has put shackles on the individual in the form of laws and seized his property under the guise of

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* On Liberty. Ticknor & Fields edition, pp. 122, 123.

benevolences and taxes, it is none the less despotism because the crime is done in the name of the people. Nor is it any the less a fit object of execration because it does not bear the title of Cæsar or the Council of Ten.

I.

That democracy should be thought the protector of freedom and property is natural. Despite the dense clouds of cant and metaphysics that have enveloped it, the idea has a historic basis. The growth of civilization has been largely an abatement of the monopoly and amount of political control. Human society did not begin, to use the phrase of Hobbes, "with the desolate freedom of the wild ass." Morgan and Maine have made it a commonplace of science that there was never a time when the members of the primitive group had the rights and immunities conferred only upon those possessed of the power of moral control. "Mankind," says Prof. Burgess, confirming the truth of a social philosophy he rejects, "does not begin with liberty. Mankind acquires liberty through civilization." * It is first subjected to a double dominion —that of custom and that of the leader become autocrat through the fortunes of war. To him belong the person and property of his subjects, to be used as whim or interest may direct. "Kings," said Louis XIV, expounding the doctrine of autocratic despotism, "are absolute lords, naturally possessing the entire and uncontrolled disposal of all property, whether belonging to the church or to the laity, to be exercised at all times with due regard to economy and to the general interests of the state." † The political philosophy of English autocracy was the same. "As the father over one family," said Sir Robert Filmer, the apologist for the despotism of Charles I, "so the king, as the father over many families, extends his care to preserve, feed, clothe, instruct, and defend the whole commonwealth. His war, his peace, his courts of justice, and all his acts of sovereignty tend only to preserve and distribute to every subordinate and inferior father and to their children their rights and privileges, so that all the duties of a king are summed up in an universal fatherly care of his people." ‡

Here is the point of departure in the long and desperate struggle against political control—a struggle that occupies the greater part of the history of civilization. If autocratic despotism has not, as in the East, deprived men of the desire to live their lives in their own way and to profit from their own skill and

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* Political Science and Constitutional Law, vol. i, p. 88.

† Works of Louis XIV, quoted by Say. Political Economy, third American edition, Philadelphia, 1827, p. 411.

‡ Two Treatises on Civil Government, by John Locke, preceded by Sir Robert Filmer's Patriarcha, p. 21.

energy, they find it intolerable. They lapse into doubt as to the divinity, benevolence, and wisdom of the master that holds them in bondage. Like the English barons, they unite to wrest from him some right or privilege, some bar to the arbitrary seizure of their person and property. With the triumph of their courage and efforts passes the power of the one to the hands of the few. As a landed aristocracy, like that of feudalism, or as a commercial oligarchy, like that of Florence and Venice, they become the new despots. They, in turn, rule by divine right; their voice is the voice of God; and disobedience to their commands becomes impiety and treason. While they have introduced, in a measure, the reign of liberty in the ordering of their own lives, the many are still the victims of unmitigated despotism. Whether it be in Greece or Italy, in Spain or England, in France or Germany, their lives and property are not their own. Describing the government of lower Austria at the close of the middle ages, Navagero tells us that there were "five sorts of persons—clergy, barons, nobles, burghers, and peasants." Of the peasants, however, "no account" was made, because they had "no voice in the Diet." But there was still a sixth sort—the servile laborers—of even less account. Yet the peasants were hardly better off than slaves. They were not merely obliged to bear much heavier taxation than the barons, nobles, and burghers, but they had no part in tempering its weight. That, as in other aristocratic countries, was the arbitrary work of the upper classes. As in other countries also, the upper classes determined their own burdens.* There was still to be won for the lower classes the same right. Not only must they be permitted to fix the amount of their taxes, but they must have exemption from arbitrary seizure; they must have impartial justice; they must have deliverance from the countless restraints upon their freedom. When these conquests of the masses over the classes have been made, there is then the advent of democracy, the power that so many fear and hate, that so many hail as the beginning of a better day. Misrepresented as it has been by friend and foe, it signifies nothing more dreadful or more wonderful than the possession of the right of every man to direct his own life as seems to him best. It is the application to politics of the fundamental principle of Protestantism—the concession of the same freedom in individual conduct as is granted in individual belief.†

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* James Russell Lowell. Collected Works, vol. vi, p. 14.

† "As it is useful," says Mill (On Liberty, Ticknor & Fields edition, p. 109), "that while mankind are imperfect, that there should be different opinions, so is it that there should be different experiments of living; that full scope should be given to varieties of character, short of injury to others, and that the worth of different modes of life should be proved practicable when any one thinks fit to try them."

Little as this truth is recognized and practiced, it lurks in the current political discussions. If it is not openly proclaimed, it is tacitly implied. Mr. Godkin defines democracy as "the participation of the whole community in the work of government." * Bringing out more distinctly the idea that it is something besides the universal possession of political power, Sir Thomas Erskine May defines it as "a principle or force, and not simply an institution." † More specific still, Mr. Lowell describes it as a "form of society, no matter what its political classification, in which every man had a chance and knew that he had it." ‡ Mr. Morley also holds that it means something more than political sovereignty put into the hands of everybody. Showing that as such it has shattered the old forms of despotism and enlarged the opportunities of life for all, high and low, rich and poor, he says: "It has shaken the strength and altered the attitude of churches, has affected the old subjection of women and modified the old conceptions of the family and of property, has exalted labor, has created and dominated the huge enginery of the press, has penetrated in a thousand subtle ways into the whole region of rights, duties, human relations, and social opportunities." # It is Boudrillart, however, that brings out the truth that democracy, properly speaking, is a form of moral control as well as a condition of freedom. After saying that modern democracy "permits a larger and larger number to enjoy the moral, intellectual, and material possessions of life," and "undertakes to substitute merit for favor and right for injustice," he adds: "It takes shelter behind the doctrine of perfectibility, which applies not only to the achievements of the human mind, to the discoveries of science, to the inventions of industry, but to the social condition and to the political and economic conditions that favor it. . . . To let each man be more and more a man," he continues, emphasizing the need of moral control to check the possible license of freedom—"that is to say, realize more perfectly the type of humanity, by the development of all that constitutes it—such is the end to which democracy aspires. Development of power for the individual and for the race—that is its ideal." ‖

II.

Finding little cheer in the contemplation of the ideal toward which the evanescence of political control and the growth of moral control have been taking the human race, the students of democracy are often weighted heavily with foreboding. It seems to portend some disaster that no man can avert. "There is no

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* Atlantic Monthly, February, 1897, p. 157.

† Democracy in Europe, preface, p. vii.

‡ Collected Works, vol. vi, p. 33.

Littell's Living Age, June 13, 1896, p. 643.

‖ Block. Dictionnaire de la Politique, vol. i, p. 635.

mincing the matter," says Mr. W. E. Forster: "unless the world goes back, democracy must go forward." * "The democratic principle," says Maine, regarding it as a militant power like some barbarian horde, "has gone forth conquering and to conquer, and its gainsayers are few and feeble." † "To attempt to arrest the progress of democracy," says De Tocqueville, in the same melancholy vein, "seems like opposition to God, and it remains for the nations of the earth to adjust themselves to the conditions imposed by Providence." ‡ But when viewed in the light of the far-reaching and hopeful inductions of Herbert Spencer, democracy, to many minds so fraught with peril to civilization, is divested of terror. They show not only why it is honored with the vast moral, intellectual, and material achievements of the last four centuries, but they show also why it is charged with the intolerable social and political evils that have blackened and still blacken the pages of history. By the operation of the law of evolution, as immutable as any law of Nature, the agencies of human effort, whatever be their purpose, have been enlarged almost to an infinite degree, and made immeasurably more perfect and useful. By the operation of another law, equally immutable, has been decreed the character of those agencies; it has determined whether the beliefs, institutions, and morals of a nation shall be those of savages or those of civilized men—those of war or those of peace.

Subjected to the solvent power of these inductions, all the phenomena of social life yield their secrets. They disclose the truth that feudalism, from which modern society took its origin, was not due to soil, nor climate, nor race; it sprang from the murder and pillage of mediæval barbarism. Of the same remorseless Fury were born its machinery of despotism and its hideous traits. She was the mother of the hatred, cruelty, greed, and lust that afflicted the world for a thousand years and still afflict it. Industry, however, has been the mother of peace, liberty, honesty, and virtue. Without security and freedom, traffic in labor and its fruits is impossible. Men must be protected from robbery; they must own themselves as well as their toil; they must have the right to exchange; they must be exempt from seizure and confiscation. Nor can traffic thrive without the benignant spirit of kindness and courtesy. It demands an effort to please, and the effort to please begets the habit of pleasing. It demands honesty and confidence, the basis of credit and a potent stimulus to enterprise. But traffic is a ship freighted with wealth, which gives leisure and permits the culture of the noble

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* Address as Lord Rector of the University of Aberdeen. Quoted by May, Democracy in Europe, vol. i, introduction, p. 29.

† Popular Government, p. 5.

‡ Démocratie en Amérique, introduction, p. 6.

side of life—literature, art, science, philosophy, philanthropy. Shall any one say, then, with Renan, that "the origin of all civilization is aristocratic," that it is "the work of aristocrats"?* On the contrary, its origin is democratic; it comes of freedom and self-control; it is the work of toil, so despised and oppressed in every feudal land.

Yet it is heard on every hand that, as civilization advances, political government—that is, the restraints of feudal despotism—must increase; otherwise the world will stop, and its lights go out. The cry is not from the throats of ignorant demagogues or rapacious politicians; it is raised by the most studious and thoughtful. "Law," said John Randolph Tucker, before the American Bar Association, "must grow with civilization, or," he added, showing that he had yet to learn what civilization means, "progress will cease, and the achievements of a people will be unworthy of their genius and their character." † Although Mr. Lecky has declared that the tendency "in the midst of the many and violent agitations of modern life to revert to archaic types of thought and custom will hereafter be considered one of the most remarkable characteristics of the nineteenth century," he, too, believes it to be "quite true that the functions of government must inevitably increase with a more complicated civilization." ‡ Even Mr. Godkin, who says most truly that "the best thing in the world is individual freedom," and that "a man who is compelled to work by law . . . is to all intents and purposes a slave," holds that "the world, through the increase of its offices and activity, needs far more regulation than it used to need." # But the growth of law, the increase of functions and regulations, the creation of officials to correspond with both, is not progress—it is, as Mr. Lecky himself hints, retrogression; it does not point to the future—it points to the past; it is not the dawn of a better day—it is a return to the curse of the middle ages. No tribute to the purpose of official machinery can hide its kinship with feudalism. Nor can any sophistry blot out the fact that such machinery is only an attempt to fit the institutions of that hated and decadent form of social life, whose object was the prosecution of war, to modern social life, whose object is the cultivation of peace and industry, as well as self-control. The current belief that it will be more successful in the future than in the past is the most amazing delusion that ever lodged in the human mind. There is no magic in the diffusion of the irresponsible power of the one among the

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* Caliban, pp. 77 and 91. Quoted by Maine, Popular Government, p. 42.

† Proceedings, Milwaukee, 1893, p. 203.

‡ Democracy and Liberty, vol. i, p. 335; vol. ii, p. 228.

# Democratic Tendencies. Problems of Democracy, p. 195, and Atlantic Monthly, February, 1897, p. 158.

irresponsible many. Wisdom and virtue do not increase with the multiplication of the greed and ignorance intrusted with the management of an important and difficult enterprise. Forty millions of despots under the hierarchy of other despots trying to force thirty millions of subjects under the same debasing rule, to live a life not their own and to contribute money to a use they have no interest in, is just as much a form of feudalism as the government of a Bourbon prince or of a council of Spartan ephors.* It is just as certain to evoke the same evils and stir up the same revolt that have overthrown every other despotism.

Ignored as this truth has been and still is in speculation and practice, it has been tacitly recognized and acted upon. That is why the tyranny of the majority has been branded as no better than the tyranny of the minority; why publicists from Aristotle to Mill and Spencer have declaimed against its perils; why so much has been done in contravention of the belief that progress is to be sought through an increase of these perils; why scheme after scheme for the selection of representatives, for the restriction of legislatures, for the appointment of officials, and for the prevention of extravagance and fraud, have been invented; why every one of them has failed, and must inevitably fail. The virtue of human wit is not greater than the virtue of human character. A system of regulation can not be devised that will not yield to some plan to subvert it.† "If, in Greece," says Polybius, describing an experience constantly duplicated in modern democracies, "the state intrusts to any one only a talent, and if it has ten checking clerks, and as many seals, and twice as many witnesses, it can not insure his honesty." ‡ But with character any political system will work; without it, none. When, however, human nature has grown perfect—that is to say, when civilization has reached its goal—political government will have ceased, and the only government will be that of self, or conscience. Such government will suffice to prevent the aggressions that philanthropists and statesmen strive in vain to suppress. It will also permit the fullest liberty, the highest development, and the greatest happiness both for the individual and for the race. "Not to crush minorities under the majority, the individual under centralization, liberty under equality," says Boudrillart, stating the problem thus solved, "that is the destiny of democracy." *

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* Here we have an explanation of Mill's statement (Liberty, Ticknor and Fields edition, pp. 135, 136) that "the spirit of improvement is not always the spirit of liberty, for it may aim at forcing improvements on an unwilling people." He adds very truly that "the only unfailing and permanent source of improvement is liberty, since by it there are as many possible independent centers of improvement as there are individuals."

† One example is the Raines law and its amendments, which led to the invention of the Raines hotel and clubs to circumvent the legislator. Another example is the new German bourse or anti-option law that the corn and produce merchants of Berlin have, according to a cablegram in the Evening Post of May 13th, discovered ways to evade.

‡ Quoted by May, Democracy in Europe, vol. i, p. 126. "The number of defalcations of county treasurers," says Mr. Roberts, Comptroller of New York (Annual Report, 1897. p. li), "brought to my attention induced me to inquire of every county clerk in the State as to whether there had been any defaulting treasurer in his county of late years. The replies received show defalcations or shortages in twenty-three counties. In some cases there was one; in some two; and in one several." Referring to "internal improvements" and other business enterprises in the United States, Prof. John W. Million says, in his State Aid to Railroads in Missouri, p. 30: "There is not a single case in the whole list of the States attempting the construction or the assistance in the construction of public works between 1825 and 1840 in which there is evidence of commanding administrative ability. In the case of almost all there is an absence of what can be called immaculate honesty." In his

III.

Nothing could be more indicative of the fact that democracy as a form of political government is only a form of despotism than the exhibition of certain traits otherwise inexplicable and absurd. As the heir of the irresponsible one and the few, it arrogates to itself their attributes of divinity, and like them exacts from its subjects a slavish homage and obedience. Although Aristotle said that in a democracy "a people knowing itself to be king assumes all his pretensions," the truth has yet to be learned and acted upon. "The modes of addressing the multitude," writes Maine, after describing democracy a second time as monarchy inverted, "are the same as the modes of addressing kings." † "O king, live forever," said the Oriental courtier as he approached his irresponsible master. ‡ "The voice of the people is the voice of God," cries the courtier of democracy. "Your ascent to power," exclaims an American Bossuet, addressing the Grand Monarch of the New World, "proceeded as uniformly and majestically as the laws of being, and was as certain as the decrees of eternity." # How the obsequious practices of despotic states have been revived under popular government has not escaped the attention of Mr. Godkin. "In talking on such subjects as the currency with a view of enlightening the people," he says, "skillful orators are very careful to repudiate all pretense of knowing anything more about the matter than their hearers." ‖ But they must do more

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review of State railroads undertaken since 1840, he finds that the causes of failure were "two in number: (1) incompetency and (2) corruption." (Ibid., p. 222.)

* Block. Dictionnaire de la Politique, vol. i, p. 640. The same view is to be found set forth in James M. Woolworth's address before the American Bar Association, Saratoga, 1896 (Proceedings, pp. 317, 318): "This is the vital and mighty fact of modern Christian civilization," he says, "the integrity of every human soul and its right to the possession, exercise, and enjoyment of all its faculties, capacities, and activities as to it seems good, and in such full measure as is consistent with the same right of others."

† Popular Government, p. 77.

‡ Spencer. Principles of Sociology, vol. ii, p. 148.

Bancroft. Quoted by Maine, p. 77.

‖ Problems of Democracy, p. 90.

than that; they must represent their hearers as omniscient. "When," said an orator in the last presidential campaign, discussing the most complex of political issues, "I see a person who says it is too difficult for the people, I find some one who says it is too deep for him. No question is too deep for the people." * Had any sycophant of Nero's time pretended to more knowledge than the tyrant himself, he would have lost his life. In these days of humane societies, however, the penalty is less severe but not less summary. Howls of derision and certain defeat await the suitor for popular favor that neglects to burn the incense so pleasing to the many, and dares to say that they not only do wrong but often do most grievous wrong; that universal suffrage, however lauded as a cure for political and social ills, never insures the choice of the most fit to rule; † that there is a deal of ignorance and crime that masquerades under the name of democracy. As well might the scoffer at the divine right of kings or the infallibility of Popes two centuries ago have expected to be received with honor and cordiality at the Vatican or the palace of Versailles.

When the power of democracy is increased—that is, when government assumes more functions, thus emulating the "universal" parent of Sir Robert Filmer's political philosophy—the more despotic, intolerant, and barbarous it becomes. ‡ More offices and privileges are thrown into the political arena to be fought for. Party organization grows stronger, and party feeling more bitter and savage. The pursuit of politics becomes a form of civil war, giving rise to its ethics and its evils. Division of the people into hostile camps follows. Military discipline, transferred to civil life,

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* William J. Bryan. Speech in Pittsburg, Pa., August 10, 1896.

† It was cited against an eminent American scholar and diplomatist, who was once mentioned for the governorship of New York, that he had written a paper in favor of a restriction of suffrage as a measure to improve the government of American cities.

‡ No one will forget the fierce but senseless resentment shown toward Minister Bayard by the press and Congress for his remarks on democracy in Boston, England, August 2, 1895, and in Edinburgh, Scotland, November 7, 1896. What he said was the exact truth. "The President," he said at Boston, "stood in the midst of a strong, self-confident, and oftentimes violent people, men who sought to have their own way. It took a real man to govern the people of the United States." The riots at Homestead, Chicago, Cleveland, Buffalo, and Pittsburg justify every word. "In my own country," he said at Edinburgh, "I have witnessed an insatiable growth of a form of socialism styled protection, which has done more to corrupt public life, to banish men of independent mind from public councils, and to lower the tone of national representation than any other cause. . . . It . . . has sapped the popular conscience by giving corrupting largesses to special classes, and it throws legislation into the political market, where jobbers and chafferers take the place of statesmen." Observe what has been going on in Washington since the introduction of the Dingley bill. But the only mistake Mr. Bayard made was in not distinguishing clearly between democracy as a form of political government and democracy as a condition of freedom under moral control. It is the former and not the latter that is responsible for the evils that he describes so accurately.

is enforced. Leaders spring up to take command of the political organizations, the modern *condottieri*, always agents of crime and despotism. They fight campaigns as they would fight battles; and they fight them with no more principle than the lawless bands that plundered Italy and Spain at the close of the middle ages.* If divided counsels are fatal in war, they are equally fatal in politics. Nothing, therefore, becomes more odious than independence in thought and action; and nothing is more sternly rebuked, and, if possible, severely punished.† Only the utmost fidelity is approved, and rewarded with either appointments, or contracts, or legislative favors. The policy adopted is, not what is right, but what is expedient. The demoralizing principles of Jesuitism assume control, and the end, which is party triumph, is made to justify its achievement by any means. Hence, caucus tricks and crimes, convention intrigue and outrage, bribery and fraud at elections, and sophistry and falsehood in political discussion. Hence, the exclusion from public life of men that loathe these practices and refuse to sell their souls to the Mephistopheles of politics. Hence the dominance of men, including even the "scholar in politics," so quickly debased, that never hesitate to purchase power by the creation of offices or by the plunder of the rich. Hence the low tone, the scenes of violence, and the marked decadence of all legislative bodies in every part of the world.

No fine phrases of social or political speculation can mask the odium of the fact that the spirit of democracy, like that of other despotisms, is selfish and sordid. The truth is exploited in every work of history and politics. "The love of exercising power," says Buckle, drawing upon his vast knowledge, "has been found to be so universal that no class of men who have possessed authority have been able to avoid abusing it." * Madison, who was a friend of democracy, thought the same. "Where there is an interest and a power to do wrong," he says, "wrong will generally be done, and not less readily by a powerful and interested party than by a powerful and interested prince." † Maine, who was quite as friendly toward aristocracy, agrees with him. "Under the shelter of one government as of the other," he says, "all sorts of selfish interests breed and multiply, speculating on its weaknesses and pretending to be its servants, agents, and delegates." ‡ Even one of the most distinguished high priests of democracy does not pretend that it will be more unselfish than any other despotism. "Having forged an instrument for democratic legislation," says Mr. Labouchere, alluding to the establishment of universal suffrage, "we shall use it." # To be sure, democracy does not propose to create hereditary privileges. It will continue to wage, as it has waged, relentless war against them, and will not cease until it has crushed them. But it creates privileges of its own not less odious nor less violative of the laws of political science and the rights of individuals. It permits its subjects to plunder one another as pitilessly as the barons of the Rhine. With the aid of duties and bounties, defended with the logic of philanthropy, manufacturers grow rich "beyond the dreams of avarice." Appealing to the same feudal argument, trades and professions gain possession of monopolies as despotic and intolerable as the mediæval corporations. Commissions, created to provide politicians with place and pelf, and duplicating the *intendants* of the old *régime*, threaten the destruction of that institution so famous in history and so dear to the American heart—local self-government. ‖ Even philanthropists, under the spell of a sympathy that eclipses their judgment, band themselves together to exercise an authority in the suppression of vivisection that will eventually subvert the freedom of science as well as the freedom of the community.

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* The parallel is quite perfect. It will be remembered that the Italian freebooters on both sides used to have "rings"—that is, understandings by which they profited as much as possible from their warfare and at the same time did each other as little damage as possible. See Prescott's Ferdinand and Isabella, vol. ii, p. 279. In Spain, as in the United States, it was found necessary for good citizens to band themselves together to secure protection from those that should have protected them. The Hermandad, or Holy Brotherhood, was the analogue of our Good Government Clubs, Citizens' Unions, etc. (Ferdinand and Isabella, vol. i, pp. 26, 186.) By the way, there could be no more convincing evidence of the capacity of people to look after themselves without the aid of the state—that is, the politician's—than the existence of such organizations as these clubs and unions throughout the country to look after the politicians. Is it not absurd to suppose people that have to form voluntary organizations to watch their government and to prevent it from driving them into bankruptcy by its incompetency and dishonesty are unfitted to form voluntary organizations to undertake enterprises that social reformers have come to imagine government alone fitted to undertake?

† A striking example of this kind of intolerance is to be found in Senator Platt's letter of May 8, 1897, on the Citizens' Union of New York. "It can't prance around," he said, "with the agile irresponsibility of a self-constituted committee of 'best citizens.' It can agree to no basis of union which substitutes the government of an individual acting wholly on his own whims and caprices for the rule of an organized responsible party performing an authorized party policy." Rather than have good government independent of any particular party organization, Senator Platt, echoing the sentiment of his lieutenant, Mr. Lauterbach, would see the triumph of its enemies.

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* History of Civilization, vol. i, p. 280.

† Quoted by F. N. Judson. Proceedings of the American Bar Association, 1891, p. 239.

‡ Popular Government, p. 87.

# Quoted by Maine, pp. 43 and 44, from Fortnightly Review of March 1, 1883.

‖ For no other purpose than the one indicated in the text, the New York State Legislature added a fourth member to the Railroad Commission. Other commissions were proposed, but the public criticism was so severe that they were abandoned.

IV.

"The really alarming feature connected with the growth of democracy," says Mr. Godkin, apparently astonished at this natural and inevitable abuse of power, "is that it does not seem to make adequate provision for the government of this new world [of modern industry]. Its chief function, like the chief function of the monarchy which it has succeeded," he adds, showing an unconscious recognition of the cause of the evil, "is to fill offices."* But what other form of despotism has ever made adequate provision for anything beyond the preservation of order and the prevention of aggression? Has not the government of the one tried it and—failed? Has not the government of the few tried it and—failed? Let the moral, intellectual, and industrial history of every country on the face of the earth answer. For centuries despotism, either autocratic or aristocratic, strove in the interest of self-preservation to regulate the beliefs of men. Even the portly volumes of Dr. White on The Warfare of Science scarcely suffice to record its incalculable harm. It made cowards, hypocrites, and martyrs. It drove virtuous and industrious populations from their homes, crippling forever Protestant France and the Spanish Netherlands. Never has it laid its fingers on any enterprise, whether its motives be greed or virtue, without blighting it like a plague, and summoning, like an evil spirit, all the malevolence that war has planted in the human heart. "The first inevitable consequence was," says Buckle, recounting its attempts to regulate trade, "that in every part of Europe there sprang into existence numerous and powerful gangs of smugglers, who lived by disobeying the laws which their ignorant rulers had imposed. These men, desperate from the fear of punishment, and accustomed to the commission of every crime, contaminated the surrounding population; introduced into peaceful villages vices formerly unknown; caused the ruin of entire families; spread, wherever they came, drunkenness, theft, and dissoluteness; and familiarized their associates with those coarse and swinish bebaucheries which were the natural habits of so vagrant and lawless a life."† Most significantly does he add that with the abolition of the laws vanished the crimes and the criminals they had created. But the despotism of democracy has yielded no better fruit. "The public have seen law defied," says President Charles W. Eliot, describing the attempts to control the American liquor traffic in the interest of virtue; "a whole generation of habitual lawbreakers, schooled in evasion and shamelessness; courts ineffective through fluctuations of policy, delays, perjuries, negligencies, and other miscarriages of justice; officers of the law double-faced and mercenary, legislators timid and insincere, candidates for office hypocritical and truckling, and officeholders unfaithful to pledges and to reasonable public expectation." *

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* Democratic Tendencies. Atlantic Monthly, February, 1897, p. 159.

† History of Civilization, vol. i, pp. 278, 279.

"But," urges some philanthropic statesman, enamored of quackery for social and political ills, "is it not possible to frame laws with sufficient skill and to get them enforced with sufficient vigor to hasten human progress? Too intolerable altogether is it to await the slow pace of evolution." Intolerable though it be, it is far less so than the remedy urged, which was foredoomed from the first to inevitable disaster. It is a flagrant violation of the law of social and physical growth. The union of merit with benefit is as vital as the union of breath with life. The severance of the one is punished with the same certainty and severity as the severance of the other. Men must not be deprived of the fruits of their talents and toil; they must not be allowed to escape the penalties attached to ignorance and indolence. Protection against this law was the inherent and destructive vice of the rule of the one and of the few; it is the vice also of the rule of the many. "When despotism," says Boudrillart, catching a glimpse of this truth, "becomes the *régime* of a nation, is it not its fatal law to revive favors and privileges, and to destroy equality for the benefit of the low and unworthy?" † As if fresh from the study of the national, State, and municipal governments of the United States, Maine replies in the affirmative. "When the ingenious legislator," he says, "had counted on producing a nation of self-denying and somewhat sentimental patriots, he finds that he has created a people of Jacobins or a people of slaves." ‡ Necessarily is it so. Self-interest, enlisted in behalf of the prostitution of public affairs, as must be the case under every form of despotism, can produce nothing but inefficiency and corruption. A powerful bureaucracy can only destroy the independence of a people and render them unfit to care for themselves. If they have not wholly lost spirit, any failure to give them relief from the woes they have been taught to charge to the government is certain to turn them into rioters and revolutionists. It did so in Greece and Rome; it did so in the Italian republics; it will do so in their modern successors.

Of the many "problems of democracy" that now vex the victims of social and political speculation, there is one at least that admits of solution. It is the utter unfitness of any class of people to exercise special dominion, even though they be "leading citizens" or distinguished philanthropists. The assumption that they are an unfailing depository of virtue to be graciously and mysteriously diffused among the poor and ignorant, so generally regarded as the greatest peril of modern democracy, is another astonishing delusion. To expose it, I shall not appeal to the lives of fighting ecclesiastics that led armies to slaughter, thus violating the gospel of peace, and practiced in private and public the current morals, nor to the lives of the philosophers and statesmen that befogged the interests of the people with sophistry and falsehood and gave themselves up to vice and crime. I can not hope to deepen the significance of the pleas of apologists that they were simply the creatures of their age, obedient only to its code of ethics. I call attention rather to history more recent and impressive—to the history of the day, which discloses a divergence quite as profound between preaching and practice. It shows that, as the morals of every class are molded by the same forces, they are very much alike. Inspect, for example, those of the wreckers of banks and railroads, and of the promoters of fraudulent enterprises. Are they better than those of the burglar or thief? Inspect, also, those of the "influential citizens" that intrigue and bribe for municipal contracts and privileges.* Do they differ from those of the ward heelers that conspire for places they are not fitted to fill, or of the public officials that peddle protection to gamblers and harlots? Inspect, again, those of the illiterate and impoverished "gang" that flock to a State Legislature to become the chartered pilferers of some metropolis. Are they worse than those of the more intelligent and prosperous "gang" that besiege the national Legislature for a similar purpose on a greater scale? Inspect, finally, those of the people that revel in books on a Corsican barbarian, in series of articles hideous with the atrocities of war, and in newspapers reeking with vulgarity and crime; that hear without a shudder of the annual slaughter of victims more numerous than the Greeks of the Anabasis; † that preach rancor and revenge toward a kindred nation that has their own institutions and their own love of freedom; that show contempt for the law of nations in their reckless clamor for the recognition of insurgents that have no status as belligerents; that lust after the territory of a primitive people and applaud the conspirators that rob them of their rights; that join with others to crush the native government of harmless tribes of South Sea islanders; that hide behind the dazzling shield of "manifest destiny" colossal schemes of aggression all over the world, and prepare for them with lavish expenditures upon a powerful navy and a vast system of coast fortifications.* Yet it is supposed that a people thus tainted from top to bottom with the ethics of feudal barbarism may be trusted with their brother's keeping—that he can have no possible need of the kindly attention of a good Samaritan.

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* Atlantic Monthly, February, 1897, pp. 179, 180.

† Block. Dictionnaire de la Politique, vol. i, p. 641.

‡ Popular Government, p. 176.

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* "Is it your men in the common walks of life," said Mayor Swift, of Chicago, quoted in the Arena, April, 1897, p. 716, "that demand bribes and who receive bribes at the hands of legislative bodies or of the Common Council? No, it is your representative citizens, your capitalists, your business men." I venture to add that the mayors of most American cities could duplicate the same experience.

† Dr. Andrew D. White has put the number at ten thousand and five hundred. He shows that it has been increasing with frightful rapidity of late years. How shocking has become the disregard of human life among people not belonging to the criminal class, may be gathered from the mobbing and murder of Chinese in the West, and from the practice of lynching, which has extended from the South to the North. Equally significant is the statement of the leader of the Florida House early last May, on the Governor's message relative to lynching, that the Southerner would always summarily punish any person guilty of criminal assault. Referring to "the unwritten but binding law of the land" which allows "a

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From democracy as a form of political government no more need be expected than from any other despotism.† Like the government of the one and of the few, the government of the many tends to crystallize society and to thwart its growth. Every law to restrict freedom and every official appointed to enforce it are steps toward a fixity of structure that will cramp and deform social life and divest it of variety or interest.‡ Already this

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husband to slay the man who has invaded his family," the Atlanta Constitution said two years before to a month, "We know it is a bad thing for one man to kill another, but it is worse to permit men to violate the sanctity of a home, and go free upon paying a fine or damages." With an extension of this law of revenge society would soon be reduced to a state of anarchy.

* In a review of one of Captain Mahan's laudations of naval barbarism, in the Political Science Quarterly, vol. ix, p. 172, Mr. Theodore Roosevelt, a brilliant representative of the spirit of modern barbarism, says: "We need to have the lesson taught again and again and yet again, that we must have a great fighting navy, in order to hold our proper position among the nations of the earth, and to do the work to which our destiny points." As though our "proper work" did not consist of strict attention to our own affairs, to the suppression of crime and the better enforcement of justice, to the reclamation of our cities from misrule and to the protection of our liberty from threatened destruction; as though "a great fighting navy" as well as a great fighting army could point to any other "destiny" than the indefinite postponement of this important work of civilization.

† M. Edmond Scherer's study of French democracy has brought him to a similar conclusion. "Je me persuade," he says, in Démocratie et la France, p. 2, "que la nature humaine restera eternellement assez semblable à elle-même, et dans tous les cas, que ce ne sont pas des formes de gouvernement ou des mesures d'économie sociale qui la modifieront."

‡ "It is not by wearing down into uniformity all that is individual in ourselves by cultivating it and calling it forth within the limits imposed by the rights and interests of others," says Mill (On Liberty, Ticknor & Fields edition, p. 121), "that human beings become a noble and beautiful object of contemplation; and as the works partake of the character of those who do them, by the same process human life also becomes rich, diversified,

tendency toward a rigid bureaucracy, with its moral perversion and industrial paralysis, has become painfully manifest. The centralization of the Federal Government, which set in so irresistibly with the civil war, has spread like a pest to the State and municipal governments, which wield an authority over the individual far in excess of the fears of the fathers. The same spirit has entered political parties and reduced them to powerful mechanisms almost military in perfection and despotism. It has seized upon the laboring man and capitalist, and arrayed them in bitter enmity and bloody conflict. It has reached the trades and professions, and developed in them the most odious traits of intolerance and monopoly. It has invaded social life even. There it has created a multitude of organizations with an exclusive and aggressive temper and a feudal love of pretension and show.* When a nation falls, like another priest of Apollo, into the strangling coils of such a system of organization, every part of which is made firm and unyielding by some law in violation of right or in concession of privilege, it has reached the limit of evolution. Immobile and unprogressive, its people, grown greedy, deceitful and barbarous,† lose the capacity to think or to care for themselves. The Government, also become depraved and incapable, degenerates into a huge machine to oppress and exploit. Thus a free democracy is turned into a Roman or Bourbon despotism that only a shock like an irruption of barbarians or a terrific explosion like a great revolution can awaken and rescue from the lethargy of death.

But from democracy as a condition of freedom under moral control, every achievement within the reach of human effort may be expected. Under its *régime* society remains fluent and mobile,

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and animating, furnishing aliment to high thoughts and elevating feelings, and strengthening the tie which binds every individual to the race, by making the race infinitely better worth belonging to."

* I refer particularly to the Colonial, Revolutionary, and Grand Army societies, and to various uniform and semi-secret orders. Referring to the recrowning of the "Queen of the Society of Holland Dames of New Netherlands," a paragraph in a daily newspaper says, "Almost royal state will be attempted, the lady riding on coronation day from her home to the Waldorf in a stately carriage drawn by six white horses, and bedecked with orange-colored ribbons and flowers." Everybody will recall the interest aroused by the exclusion from one of these societies of a descendant of Benjamin Franklin, on the ground that his relations with women had not been above reproach. For a further account of the Colonial societies, see Ladies' Home Journal, July, 1897, p. 10.

† Evidence of this spirit is to be found already in the various trades and professions that seek protective legislation, and also in the testimony of the tariff beggars before the Ways and Means Committee last winter. They show hardly more consideration for their victims than would a wolf for an infant it had found playing in its path. People really civilized could never have permitted the legislation that threw thousands of Welsh tin-plate makers and Austrian button makers out of employment subsequent to the enactment of the McKinley bill in 1890.

ready to assume the countless forms that meet the ever-changing needs of human life. There is no interference with either the law of evolution, which is left to work its miracles, nor with the law that merit shall be the measure of benefit. Subjected to their powerful stimulus, the individual, neither cramped nor plundered by an ignorant and greedy bureaucratic despotism, is impelled to make the most of his talents and opportunities. He is free to struggle and experiment with himself and with the world in every direction. Not protected from the evils of his blunders by an unwise philanthropy nor deprived of the fruits of his successes by confiscatory taxes, he learns to avoid the one and to strive for the other. What is beyond his own achievement he induces his fellows to help him achieve. Whether the object be one of personal profit or public benefit, that alone is the true method. It is the method that will enable men to execute the most important commercial enterprises, like the construction of canals and railroads, and to work out the weightiest moral reforms, like the abolition of intemperance and the mitigation of cruelty. It was the method of the founders of the great religious orders of the middle ages; it is the method of the founders of the great church and secular societies of to-day.* The modern industrial system, unparalleled in history, had the same origin. Not only without the aid of statesmen, but often hampered and almost crushed by their vicious meddling,† its founders have turned forests and deserts into farms and gardens, covered continents and seas with lines of transportation, and filled cities with markets, banks, and exchanges. Thus are avoided the evils of every form of despotism. There is no longer the incentive to practice the ethics of war. No one is forced to surrender his liberty without consent, or to part with his property except by gift or contract. Nor is he obliged to change his thought ‡ or mode of life at any behest but that of persuasion and conviction.

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* Note the Epworth League, the King's Daughters, and the Young People's Association of Christian Endeavor. Note also the League of American Wheelmen and the savings and loan associations.

† "No great political improvement," says Buckle (History of Civilization, vol. i, p. 272), "no great reform, either legislative or executive, has ever been originated in any country by its rulers." Even in our own country Congressman Loud made a desperate but futile attempt to reform the postal service and to turn the constant deficit into a surplus. The perpetuation of the seed-distribution evil, despite the efforts of Secretary Morton, is another example of the tenacity of the same trait of bureaucratic despotism.

‡ Everybody is familiar with the intolerance of ecclesiastical despotism; but the intolerance of political despotism is not so much thought about, especially under popular governments. I do not refer altogether to the intolerance of trade unionism nor to that of party organizations, nor even to that of both to foreign immigrants, which are very marked in the United States and sufficiently significant of retrogression. I refer more particularly to the intolerance that denounces the teaching of free trade in colleges and universities; that

Whatever power may be needed beyond the conscience of men to control their conduct will be that of rational public opinion. As a matter of fact, it is the only power at any stage of social progress that has validity or efficacy. Without it neither the autocrat nor the democrat can command the slightest allegiance. But no truth is more persistently and disastrously ignored. Although public opinion can make dissent from a Hebrew myth or from a rule of evening dress more culpable than the deception of a customs collector or a tax official, modern social reformers put their faith in a power that has no authority without it. Instead of appealing to Cæsar himself, who alone wields the scepter, they appeal to Cæsar's slaves, who obey his will and incline to his vices. But every act of a legislator that abridges a right or confers a privilege twists the convictions and perverts the morals of every person affected. As this despotism grows, no matter what name it bears, public opinion becomes more depraved and less fitted to be the arbiter of social welfare. It sets up false standards of belief and conduct.* In the end it will justify bribery and plunder, as during the degradation of the Swiss,† and even assassination, as

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excludes from such institutions, as in Kansas, the professors that oppose populism; that requires an official history of the civil war to be taught in the public schools. Should wheat production and distribution become a function of the Government, I doubt not that prescribed or "official" views in regard to it would spring up, as in regard to the tariff and the currency, and that instruction in them in all State institutions would be demanded. Still another amazing example of intolerance is to be found in an article from the Democrat and Chronicle (July 2, 1897) of Rochester, N. Y., the largest and most influential Republican newspaper in the State outside of New York city. "A college president," it says, exhibiting the same spirit as that of the measure before the Prussian Diet to suppress critics of the Government or of Prussian institutions, "ought to have full power to drive out by force and arms, if need be, college professors who belittle American history and cast reflections upon our system of government. In recent years some of the colleges have become teachers of pessimism in history and politics, sending out narrow-minded critics of American institutions. A correspondent of the Sun, E. A. Scribner, a graduate of Bowdoin, suggests a chair of 'American Patriotism' in every college. There is need of such a chair in several institutions."

* How far public opinion has been perverted in the United States by this influence may be gathered from an address of Dr. Rainsford before the Woman's Auxiliary to the Civil Service Reform Association, reported in the Evening Post, May 6, 1897. "Dr. Rainsford," it says, "administered a scathing rebuke to those who excuse corrupt practices on the part of politicians and others in power on the ground of expediency. Educated men who accepted such things as necessary evils were the most to blame, and committed the greatest crime against democratic institutions. He thought that the distrust manifested in some quarters arose from the fact that the country was honeycombed with the idea that 'pulls,' 'deals,' buying of legislation, and similar practices is the only way to get things through. Continuing, 'I heard a member of the City Club declare that it was legitimate to buy legislation at Albany.'" I, too, have heard respectable men express the same opinion.

† "La corruption par l'or étranger pénétra chez les députés aux diètes fédérales: l'assentiment des peuples dans les cantons fut obtenu par des dons annuels décorés du nom des pensions." (Morin, Histoire politique de la Suisse, vol. i, p. 101.)

after the collapse of the Italian republics.* Thus, without banishing the devils of freedom, the reformers, moved to such endless efforts to keep swept and garnished, evoke only the devils of despotism, which are immeasurably more ferocious and destructive.

A TORTOISE-SHELL WILD CAT.

By WILLIAM H. BALLOU.

THE cat family has given naturalists quite as much trouble as it has the ordinary citizen in his efforts to repose at night. The wild type (or types) of the domestic animal has never been located, although various views have been advanced to account for the household pet. As far back as we can distinguish man arising on the horizon of history, we find him accompanied by certain domestic animals, the origins of which are quite as involved in problems of transition conditions as is man himself. The late Dr. J. S. Newberry was wont to exhibit to me a mummified alleged cat from Egypt, to show that the domestic animal of the Egyptians was really a civet. The late Prof. Cope thought that perhaps all living species of wild cats had been defined, until *Felis bracatta* was sent him from Brazil; he thought it probable that there were no more extinct *Felidæ* to be discovered until, just before his death, a pocket containing several new types was opened in a Philadelphia quarry not far from his laboratory.

I have always taken an interest in the origin of the domestic cat, not the least diminished by these two lamented paleontologists, who could find no technical basis for any theories that have been advanced. No wild cat has been tamed in modern times, and years of confinement and kindness have wholly failed to soften the savage nature of these denizens of the forest and jungle, some representatives of which will instantly attack man or beast, oblivious to overwhelming odds, and fight to the last gasp. I have always inclined to the multi-origin of various types of domestic cats, holding that wild types in various parts of the earth gave origin to the domestic types therein found. It is impossible for me to reconcile to a common existing wild ancestor the domestic cat of the Isle of Malta, the stub-tailed Manx cat of the Isle of Man, and the tortoise-shell cat of Brazil—all well-known domestic types.

It was therefore with great interest that I viewed in the late

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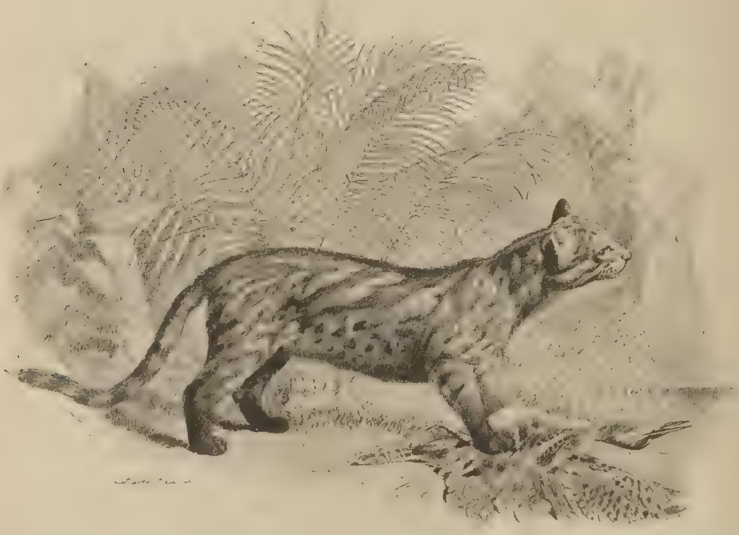
* "Tyrannicide was extolled as a patriotic virtue. . . . Public honors were paid to Donatello's statue of Judith the tyrannicide, erected in Florence, with the inscription '*Exemplum salutis publicæ cives posuere!*' While such a spirit prevailed in society, tyrants lived in constant dread of assassination." (May, Democracy in Europe, vol. i, p. 323.)

Prof. Edward D. Cope's laboratory at Philadelphia, during the past winter, the *Felis bracatta* from southern Brazil. The size of the animal is that of the domestic type, and its coloration is very near to that of the tortoise-shell pet. Prof. Cope would tell you that its only structural resemblance was to that of *Felis jaguarondi*, a common Brazilian wild cat of similar size. It would seem that color and size might be at least suggestive, when structural variation might possibly be accounted for by long years of domestication, changes in environment and food. But this is mere theorizing, an approach to venturesome ground, of which the paleontologist has a natural horror. At another time and in another article I propose to point out certain interesting resemblances between types of domestic and types of wild cats, even at the expense of being criticised by my friends who stand by teeth, skull, vertebræ, and claws. I propose to assume that the ancients had patience and good methods of reducing wild animals. The origin of the cat is as much of a mystery as the north pole, and entitled to the same venturesome exploration. Paleontology can throw no light whatever on the domestication of animals. Zoölogy has so far rendered no material assistance.



Felis bracatta (Cope). Southern Brazil.

Only one specimen of the new Brazilian wild cat is in existence. Not long since Prof. Cope found the skin in a musty old box, where he had labeled it *Felis bracatta*, and hurriedly placed it long ago. He had this skin mounted, and the new work of taxidermic art became a favorite on his wide writing desk, together with the skull of a primitive Japanese, the femur of a camarasaur, a live Gila monster, and a live turtle. The bracatta was found in the great forests of southern Brazil. Its chief value lies in the fact that it is the only specimen in existence, and modern values are based on the rarity of the commodity. Bracatta has a protective advantage in its colors, which are such that it would scarcely be distinguished, even in motion, from the dead leaves, soil, or rocks, accounting for a ready escape from enemies and an easy capture of prey, presumably small birds and mammals. Its general color is brown and shades of brown, suggestive, on the whole, of tortoise shell. The shading extends obliquely down the back toward the hind legs. The hair is long and very fine. The beautiful, dark, striped tail is nearly the length of the body, exclusive of the neck. Underneath the cat is spotted after the manner of leopards, and the legs have dark bands and boots. It is a slender, tapering, and graceful animal. Its markings are plain, suggesting the beautiful in simplicity, which aid in its general harmony with surroundings and to conceal it from the eye. It has black and gray ears of moderate size, with long inside hairs of a buff color. The whiskers are long and buff-colored, with black bases. Below each nostril and above each eye are buff spots; the cheeks are yellowish brown; the chin is a pale buff, and the throat has three rows of brown spots; the tip of the tail is black; the feet are small.

Prof. Cope pronounced the animal new to science because it was allied to only one species, *Felis jaguarondi*, and was possessed of characters which appeared to him to be distinct. The jaguarondi is a wild cat of similar size from the same locality, but its structural differences are notable. These structural differences are visible at almost every point of comparison, applying to feet, toes, claws, tail, ears, fur, and coloration. The aggregate of these characters indicates the specific differences.

Accompanying this article is a drawing of the bracatta as he probably appeared in life and environment. A mounted skin is necessarily more or less contracted and distorted. I think, however, the artist has effected the proper catlike proportions and markings with much fidelity to Nature.

It will be noted that the harmony of all this coloration is best expressed by the general term of tortoise shell. Its love of small birds and mice further suggests the domestic cat. Perhaps future capture of the species and a study of its habits in the wild state may disclose its relations, if any, with the tortoise shell of the fireside. At least it has the merit of being the nearest approach yet found to this particular domestic type.

ANTHROPOLOGY A UNIVERSITY STUDY.

By JOHN S. FLAGG,

PROFESSOR OF BIOLOGY AND EMBRYOLOGY, AND LECTURER ON ANTHROPOLOGY AT THE COLLEGE OF PHYSICIANS AND SURGEONS, BOSTON, MASS.

ANTHROPOLOGY, the science of man, has been in the past a term of comparatively narrow significance. Journals of anthropological societies all show a habit of thought along a few restricted lines. Under the old scholastic *régime* the departments of archæology and written history comprised nearly the sum total of anthropological study, all other studies appearing to be related, though but slightly, in a fixed cosmogony. Later, ethnology, as a truly scientific study, apart from history and comparative philology, has crept in as a growing realization of the interdependence of all knowledge arose.

The marvelous results of scientific investigation with which the workers of this century have blessed us, and above all the far-reaching generalizations which great but exact minds like Darwin's and Spencer's have given us, have so unified scientific thought that the student has been obliged to enlarge his use of the term anthropology to embrace the new and broader concept. He now realizes that every department of study is necessarily a department of anthropology, in that every branch of knowledge has some contribution to make toward the solution of that greatest of all problems to us, What is man—how did he originate, and how arose his characters and customs? As it was realized that man was a result of all precedent causes that had acted in his line, and as no activity, however remote, but had some effect on this line, either mediately or immediately, the concept became ever larger, until now the term anthropology really conveys the idea of a broad synthetic philosophy, built up from verified and ever-verifiable data alone—the great law of the evolution of all things and the harmonious mass of laws relating to detail, which shows the universe a logical series of causes and effects. While each separate department of science is busy adding new data to the mass of detail, correcting by careful and constant verification and a juster appreciation of values the false concept that some previous fact has given birth to, anthropology fits each new fact, so far as it bears on the problem of man, into its proper place in the whole; sees hitherto unknown relationships to facts discovered in other lines of research; traces further and further through the web of things the warp threads of unvarying law. As the master builder carries within his mind the concept of the finished building, to whose realization every workman contributes by adding each his stone, so a perfect anthropology can be realized only by the contribution of every fact dug out by tireless and devoted research, fitted together by workers equally tireless, equally devoted. Isolated facts are of little value for the advancement of human knowledge; it is only when correlated—brought into their proper relationship to other data—that they are able to yield their full quota of aid.

For more than two thousand years speculative philosophy has dominated the schools, and in all that time has made no actual advance toward explaining the nature of man or his relationship to his environment.

Tied to the ever-varying and unverifiable personal equation, there could not be a sound basis for a worthy superstructure. It was not until Herbert Spencer, taking as the basis of his deductions those objective activities from which alone the subjective states of another can be judged, reared his splendid synthetic philosophy, which is destined to supplant all others as a system, even if every detailed deduction made by him were disproved.

If anthropology, then, comprises every department of human learning, it might seem that a university is as a whole devoted to the study of anthropology, that its various departments are branches of this one universal study. Were universities ideal institutions of learning, and had they been reared at once on a true scientific basis, this might be so. Then, again, anthropology views the details of each branch of research chiefly with reference to its bearing on the evolution and present status of man, while the active specialist as an earnest searcher for truth must wrest from the unknown each minutest fact in his own domain.

Were a university curriculum arranged on a perfect scheme of anthropological unity, the time at a student's disposal would not permit him to gain any adequate acquaintance therewith. Desirable as it might be to have a university founded on such a scheme of logical unity, yet it would fail in giving the student a complete grasp of the interdependence of all phenomena through its very multiplicity of detail.

As our universities are constituted, where is there one that has a definite curriculum so arranged that its various departments bear any true relationship to the whole, whose scheme of training is so arranged that there arises in the student's mind any conception of unity?

The very requirements for admission and the consequent training furnished by the preparatory school are based almost wholly on the old scholastic mode and Platonic cosmogony. The minor colleges, having set courses, are still controlled by the same influences. The larger colleges, having professional schools attached, and aspiring to the broader title of universities, pile all the intellectual food on the table at once, and the hungry rush in and help themselves to whatever is within their reach, and come away at least self-satisfied. The few minds that are synthetic either by nature or early training are those that reap the highest good; the rest have at most sharpened their wits or gained a pert self-esteem, while many are unfitted for a life of action.

Ingersoll's brilliant sentence in his Lincoln lecture has not a little truth in it: "Colleges are places where pebbles are polished but diamonds are dimmed." The truth that lies in this sentence will be true so long as colleges remain a series of parthenogenetic scholasticisms unfit to cope with the hard environment in which mankind must live.

Our higher schools have in the past had to deal with only a limited and favored portion of mankind, but with each succeeding generation of students they have had to go down deeper among the producing people, and at each succeeding stage they have more or less closely reflected the general average of those with whom they dealt. People, colleges, and civilization have all evolved together, *pari passu*. Just now all are in a state of transition. In the colleges even scholasticism is slowly giving way before the assaults of exact knowledge. One is encouraged at seeing the rapid increase of laboratories, and the lengthening courses in English and economics, and the diminishing proportion of time devoted to the classics. Would that one might say the same of speculative philosophy! Its value as now studied, save as an exercise in mental gymnastics, was aptly characterized by one of the best-known professors of philosophy in this country, when he said to me, "Philosophy is wind, and he that can sell his wind at the highest figure is the greatest philosopher."

The history of the growth of philosophic thought, studied as a branch of anthropology, is of value, as the history of the slow growth in any other department of human thought or effort is valuable—no more.

The real value of anthropology, then, as a university study is to take the place that philosophy occupied in the old scholastic system, save that synthetic philosophy, under whatever name, requires a broad basis of accurate knowledge. He that would teach must have a mind of largest grasp, capable of far-reaching generalizations, rigidly ruled by absolute fact. To this end preliminary training in exact investigation is indispensable, that he may be familiar with the road to truth and readily detect the verified from the speculative. On the other hand, he must not be a mere delver for facts. Men who are justly noted as investigators are constantly proving themselves unfit for generalized deductions even in their own departments. The teacher of anthropology must be accurately acquainted with results in astronomy, geology, paleontology, biology and embryology, ethnology and archæology, philology, sociology, and economics.

Above all, he must be a devoted lover of truth and unwavering in its search. He must never be led away by an unsupported theory, however seductive.

It has been said in the past that great men make great men, that the influence of a great mind on plastic youth is invaluable; and it is as true now as ever. But the concept of what makes a great mind has changed. In an age of scholasticism, with an almost universal adherence to a fixed cosmogony, that man was great who by his personality and the influence that it carried could transfer that cosmogony as a whole to the minds of his pupils and the code of its ethics to the guidance of their lives. It is one of the glories of the new scientific thought that there can be no completed cosmogony, that it is ever growing and being rectified with each new truth discovered. The example of noble men of the past and the study of their deeds may stimulate others to live like them still. But for building up a stable character, the baseless, shifting philosophy of the past can never equal the study of exact truth as expressed in natural law and the humble facts of our own being. Nature never lies to her children if they stop and listen. There is more rigid, unprevaricating response to an honest query in a right angle than in all the sophistry of the schools. The young man that is thrust out into the world of action now, with only the scholastic cosmogony as a support for his moral code, is to be pitied when he finds his foundation swept away, as it surely will be if he truly thinks. How much more sturdy he would have been had he been led to clearly see the social necessities that step by step gave rise to moral law—law that grows higher and broader with social need and raises ever to its own level its own creators!

A QUITE original system of raising revenue is described by Mr. Hugh Clifford as existing in the Malay state of Trengganu. "It is managed in one of two ways. Either a consignment of goods is sent to the village or to an individual, and a price considerably in excess of that current in the markets is demanded in return for them; or else a small sum of money is sent, and a message is conveyed to the recipients that a given quantity of *getah* or jungle produce is demanded in return. On the receipt of a *serah* a village headman calls his people together and enforces a public subscription to meet the sum required by the *raja*. The things are then divided among the subscribers, but as the quantity of goods is altogether out of keeping with the high price paid for them, and as the village elders usually insist on receiving the full value of their subscription, the weaker members of the community get little or nothing in return for their money." The other form of assessment likewise works oppressively upon its victim.

STONES IN THE HEAD.

By Dr. A. CARTAZ.

IN all times painters have been fond of reproducing scenes of medical life, but the tendency has never been more marked than it was in the middle ages. Taking to the very life the oddest-seeming subjects, they have presented with the hands of masters the realistic pictures of the most various nervous troubles and pathological afflictions. On celebrated canvases may be seen, in attitudes of the most scrupulous exactness, the likenesses of great nervous affections like hysteria, malformations, clubfoot, and rickets. The great book of Charcot and Richer, *Les démoniaques et les malades dans l'art* (Demoniacs and Invalids in Art), has brought out into the light the large number of ancient works in which scenes of that kind are to be found. Yet they deal with only one special point in pathology.

A gentleman whose artistic erudition is equal to his medical knowledge, Dr. Henry Meige, has in his turn been gleaning in a rich field for observations, and has given us, in a series of remarkable studies in the New Iconography of the Salpêtrière, a sagacious and interesting critical estimate of the "painters of medicine." A recent memoir of his concerns pictures illustrating operations on the head.

We find these scenes of medical life most frequently reproduced, whether in a realistic or a satirical fashion, in the Flemish and Dutch schools. There are pictures giving a vivid image of a woman dying of hydropsy of the heart, as in Gerard Dow's celebrated canvas in the Louvre; of a young victim of anæmia, as in "The Patient" of Van Hoogstraaten, at Amsterdam; of a hysterical sufferer, as in "The Possessed" of Rubens, etc. But these pictures are most frequently figures of charlatans and really caricatures; subjects were abundant, for in that day, as in our own time, quacks and tooth-pullers were not idle. As in our fairs and parades, street operators and doctors and quacks of all sorts made display of their knowledge in public, and their address was not lacking in wit or warmth. Such scenes as these the Flemish painters strove especially to represent, castigating the quacks with their satirical pencils.

The pictures which we present to our readers repeat scenes from the operations for stone in the head. It may be asked, What was the operation which the painter intended to ridicule? There exist on the hairy part of the skin no such calculous products as are found in the canals of some of the glands or in some of the reservoirs of the organism, like the biliary vesicle or the bladder. We only know as tumors that might lend themselves to the operations of wandering quacks or mountebanks, such as the pictures represent, the sebaceous cyst or the common pimple, the caseous contents of which may possibly become chalky and hard like a stone. There are also pimples scattered over the forehead and the cranium which may be freed from their cores by a stroke or two of the bistoury. Large operations on the head were certainly known in those days; for trepanation, with which Hippocrates was acquainted, goes back, as any anthropologist will tell us, to prehistoric times. But our quacks could not have become skillful in such bold attempts; and if they had only pimples to remove, there would have been no need of making a triumphant display of a stone or of piles of stones.

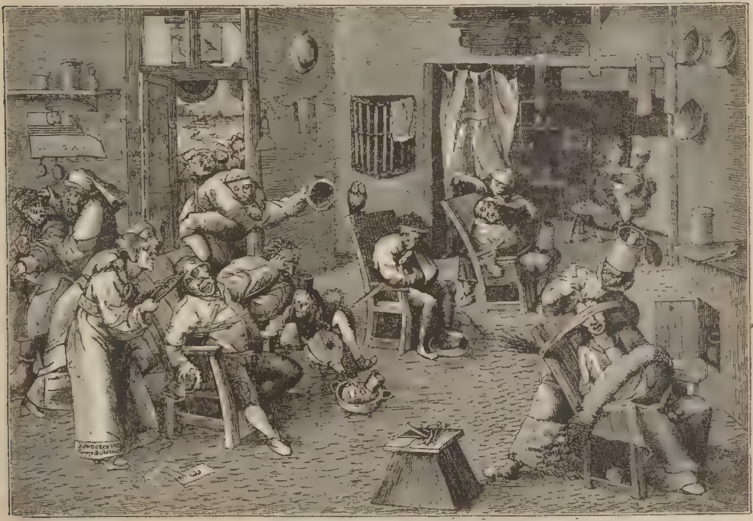


Fig. 1.—"Stones in the Head." An engraving from the picture of Pierre Brueghel le Vieux, in the engravings room of the Amsterdam Museum. (Flemish school of the sixteenth century.)

In his very judicious interpretation of these pictures, Dr. Henry Meige concludes that they relate to operations which were for the most part purely factitious and addressed to subjects of disordered minds. Instead of talking of bees in their bonnets, they said in the fifteenth and sixteenth centuries of persons a little off the balance that they had a stone in their head; and if one of such unfortunates happened to recover, they said, just as carelessly, that a stone had been taken out of his head.

When such a way of talking was current with the public, what is there to surprise one that the quacks of the period should be on the lookout to make innocent and half-witted persons believe that they were masters of the surest process to cure them of their terrible infirmity? Do we not see in our own time patients persuaded that a snake is devouring their insides, that their skull is bored with a gimlet? Do we not see simple maniacs possessed by like ideas? Are there not neurasthenics who have a helmet weighing upon their head and compressing their brain? Have not hysterics their famous nail? And would not all these people of those times, less cultivated than in our time, however high their position may have been, be willing, in the paroxysms of their suffering, to submit to any operation that might be suggested in order to be delivered permanently? It was so formerly, and more especially in the era when sorcery had lost none of its prestige. It therefore seems logical to us to regard these operations, as Dr. Meige does, as pure deceptions of quacks; furthermore, we have the pictures to prove this.

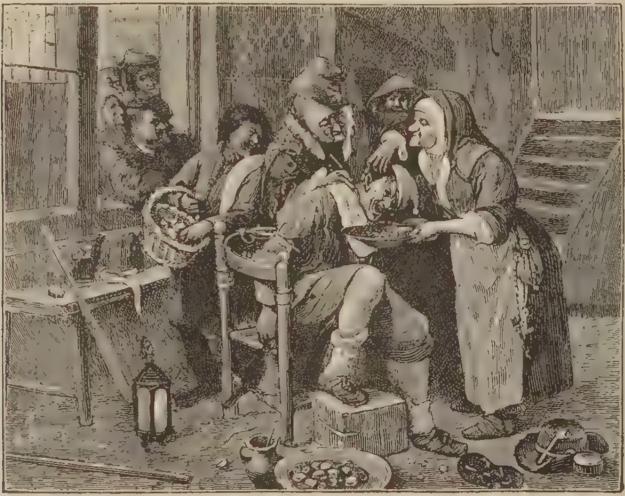


Fig. 2.—"Stones in the Head." Picture by Jan Steen. Boijmans Museum, Rotterdam.

Let us look, for example, at the painting of Brueghel le Vieux, in the Amsterdam Museum (Fig. 1). We are in a busy doctor's shop, where operations are performed without truce or mercy. Three surgeons are not too many to attend to the throng of patients. One rustic, already operated upon, looks slyly at his neighbor who is howling with pain and pushes away the assistants, while the operator is preparing, with formidable-looking forceps in his hands, to extract the troublesome stone. On the right, another operator, his head covered with a queer-looking long cap, is opening the incision through which deliverance is to come. In the background, an assistant is practicing upon a corpulent old fellow, while a fourth is trying to retain an unfortunate who is making for the door. These scenes of pain make no impression upon the monks, one of them prostrate and exhausted and carried by a good rustic who salutes the company with his fur cap, while another is exhibiting his affliction and asking for deliverance from it.

Another design, likewise by Brueghel le Vieux, is still more suggestive. It is a bald caricature, directly aimed against the quacks. The scene is not laid in a shop, but in the open air, with a staging put upon barrels, on which the operator (alone this time) exercises his wonderful talent. The crowd is gathering around him, presenting a curious series of types; some gaping with astonishment, some frightened, and others rejoicing as if at the approach of deliverance. One unfortunate has just passed through the hands of the operator; an assistant is applying a restorative liniment to the open wound, while the victim is gazing sadly at the pebble which is supposed to have been taken from his head. Another one is about to be placed in the fatal chair; the surgeon with his lantern carefully examines the offensive body. The patient howls, but a matron holds his head firmly. Another one is being brought up with a tumor larger than an orange on his head. Hidden under a stool is a confederate with a basket full of stones, ready to be passed at the proper moment, as the ball is passed to the juggler—and he is a confederate who can be relied upon, for his lips are closed by a padlock to secure his silence. The satirical intention of this curious picture has been marked by the painter himself in the little sketch outside of its lines on which he has placed his signature. It is a large egg containing an operator and his victim, with stones raining from the patient's head and falling out of the shell.

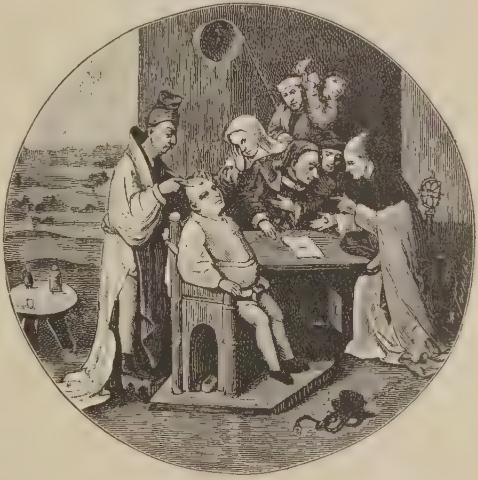


FIG. 3.—"STONES IN THE HEAD." Picture by van Achen (van Bosch). Amsterdam Museum. (Dutch school of the sixteenth century.)

A like satirical intent may be found in Jan Steen's picture (Fig. 2), although the scene is treated less fancifully. The operator may have been a well-known man; he does not operate in a public place, but at home, in a comfortable Dutch interior; but he is not without skillful accomplices—the matron, his habitual assistant, with her cunning expression, and the urchin who laughs at the humbug of the thing, as he passes the pebbles which the crafty charlatan causes to roll over the neck of the suffering patient.

The scene represented in Jerome van Achen's picture (Fig. 3) would be considered less grotesque were it not for the fantastic dress and appearance of the operator; his robe, his cap, down to the curious stool he stands upon—all are extraordinary. The quiet figure of the patient is no less so. Surely, if any such stones had been taken from his head as the other doctor is showing to the assistants, it must have been with the aid of a local anæsthetic. He beams with as happy an expression as if a most grievous pain had just gone away from him by enchantment.

M. Meige has collected more than a dozen pictures representing these operations for stone in the head.—*Translated for the Popular Science Monthly from La Nature.*

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A LILLIPUTIAN MONSTER.

By ROBERT BLIGHT.

IN front of a sunny window there stands, on a small bamboo table, an aquarium of very unpretentious appearance and size. It is nothing more than a "globe," such as is used for goldfish. In the bottom are a couple of inches of river sand, with a thin layer of gravel, which was repeatedly washed before it was placed there. Planted in the sand is a plant of water starwort, as well as one of anacharis, while on the surface float a few plants of duckweed; and two or three water snails complete the arrangement. Around the rim of the globe is tied a string on which is threaded a screen of dark-green material, which can be drawn so as to shade the globe or to admit the sunlight at pleasure.

Occasionally I amuse myself by fetching a pailful of water from the stream that runs through the meadows; and as I take up the water I give the grass and water weeds a good shake to get whatever creatures may be hiding there. I have provided two pieces of glass tubing of equal diameter—one about two feet in length, the other only some fourteen inches; and these I have bent nearly double by the heat of a spirit lamp. Thus equipped, I change some of the water. I place a footstool or a pile of books covered with a newspaper on the table, so as to get a surface as high as the top of the globe. On this I place a "Mason jar," borrowed from the kitchen, filled with the water from the stream. By the side of the globe I place another jar, empty. Taking the shorter tube, I place one end in the aquarium and give a quick draw with my lips, slipping the end instantly into the empty jar. As soon as I see that the water is flowing through the siphon I repeat the operation with the full jar, and, as the leg of the siphon is sufficiently long, the water runs from the jar into the bottom of the globe. Thus a current is set up in which the plants wave back and forth, and from the liveliness of the living creatures it is evident that they enjoy the sensation. When I see that the upper jar is nearly empty, I remove the siphon from the lower one, and the replenishing of my "tank" is at an end.

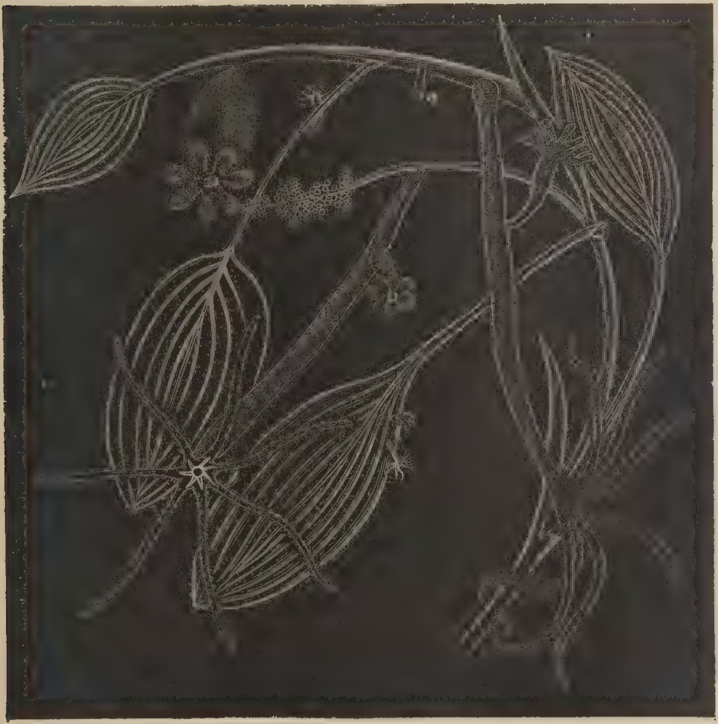

Fig. 1.—Hydra Vulgaris.

Few can tell how much pleasure is obtained from this apparently trifling "hobby," but it really is intense. Close at hand is the microscope, and on the table, ready for use, lie a piece of glass tubing for a pipette, a zoöphyte trough, a pair of forceps, and an ordinary pocket magnifier. It is easy, when anything is wanted, to take it out, either with the pipette or the forceps, and transfer it to the trough. By holding it up to the light one can readily see whether it is worth while to sit down at the other table and use the much more powerful aid of the binocular microscope.

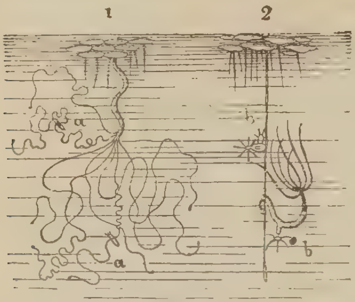

Fig. 2.—The Fresh-water Hydra hanging from Duckweed in a Pond: 1, the long-armed hydra (*Hydra fusca*) feeding; *a a*, small animals caught in its arms; 2, short-armed hydra (*Hydra viridis*) throwing off young hydra buds, *b b*.

My friends, it is true, laugh at me, and I laugh at them. They wonder why I am so devoted to "a glass globe full of water, with a few plants and snails," and I tell them that while they see much to admire in horticulture, agriculture, and a host of other "cultures," I am an enthusiast about hydra-culture. Indeed, in this small and insignificant aquarium I have a flock of fresh-water polyps, called "hydras," full of interest, full of wonder. I envy Trembley, who in 1744 published A Memoir on the Fresh-water Polyp, the intense pleasure he felt in unraveling the life history of these creatures. He was investigating the unknown when he studied the strange phenomena connected with them, and was transported with astonishment. I know, from the labors of others, what to expect, and yet I am lost in wonder.

We may be thankful that these animals are as small as they are; for, if they were only a few feet in length, we should have in our water world many a repetition of the devastation said to have been caused by the Lernæan Hydra, whose destruction was one of the gigantic labors of the hero Hercules. As it is, the longest you can find is only an inch in length. They can, however, be easily seen with the unaided eye, and with the help of a pocket lens can to some extent be studied. In fact, Trembley, the famous observer of them, had nothing better. It is only when we wish to examine minute details that the use of the elaborate microscope is called for. A group of them attached to the rootlets of duckweed or the under side of the leaves or on the stems of plants is a curious sight. A nearer view may often be obtained, for they will attach themselves to the side of the glass to enjoy the light, which they seem to love.

The commonest species of hydras may easily be distinguished by their color, one being usually a reddish brown, while the other is a vivid green. The particular shade of color of the former depends on the nature of the food captured; and it is said that it has been colored blue, red, and white by feeding it with matter stained with these pigments. Other species have been noticed, but they are less common, and some are rarely met with.

A single individual may be thus described: There is the body, like a thick thread, of varying length up to an inch. At the foot the substance is slightly expanded into a small disk, with which the creature fixes itself to some surface; at the top is a series of arms or tentacles, thin, threadlike, and arranged symmetrically around the end of the stem, which is the mouth. These tentacles vary in number, the green hydra having from six to ten, and the brown one from seven to twelve. As the trunk sways this way and that in a slight degree, and the tentacles twist about, the sight is a curious one and well worth while watching. The arms have the power of contracting, and sometimes look like little buds around the mouth; and the trunk itself will also sink down until it seems to be a small mass of jelly.

The trunk is nothing but a stomach. There are no lungs, no liver, no heart, no intestines, no nervous system. All there is consists of two layers of tissue, with a very delicate layer between. The trunk and the tentacles are alike in structure, and are simple hollow tubes. If the latter are examined with a magnifying glass, they are found to be covered with little warts, which are technically called "urticating" or stinging organs. These consist of an oval capsule, the top of which is turned back into itself so as to form a cavity in which there lies a thread coiled up, while round the edge of the cavity are four little darts. In this introverted capsule the thread lies bathed in a poisonous secretion, and the darts are nothing more or less than poisoned arrows. The opening is provided with a sort of trigger, so that when any substance is pressed against it the capsule is flung outward, the thread is cast round the opposing body, and the poisoned arrows are projected into its substance if it is penetrable.

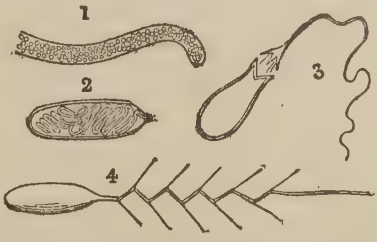

Fig. 3.—Lasso Cells of the Hydra and Sea Anemone: 1, piece of one of the hydra's arms, showing the cells crowded in it; 2, one of the cells; 3, the same cell after bursting open; 4, lasso cell of an anemone.

The hydra lives on minute aquatic creatures, and is exclusively carnivorous. Attached to its moorings, it spreads its arms in every direction with a searching motion; and although the two commonest forms can not explore at a much greater distance than the height of the body, the "fuscous" species—one of the rare forms—has tentacles which can reach some seven or eight inches. As soon as a victim touches the subtle angling line it is seized by it, enveloped in the threads, and struck by the darts. Then begins a tussle which generally ends in the captive being conveyed to the mouth. Occasionally some strong swimmer may get away, but, unless he is armor-plated, he has but little chance of his life, for a poisoned dart is most probably imbedded in his body. Sometimes a victim is very troublesome, and, in order to get it safely into its mouth, the tentacle itself must also be partially ingulfed, and it remains so until the morsel is quiet, and even until digestion has begun. As the food is drawn in, you can see the body swell, and in some cases become quite pear-shaped. After a while the swelling subsides, and, after all the useful part of the food has been extracted, the rest is ejected at the same place at which it entered. It is most interesting to watch the instinctive motions of this creature, which is totally destitute of what we should call brain.

Hitherto we have spoken only of a single individual, but we must now notice a startling fact. The hydra is multiplied according to the usual law—by eggs, it is true; but also in another way. You can not examine a group in summer time without finding that they "bud." You see the trunk of one bearing a second, perfect in every respect, except that it is connected with its parent, instead of resting on a foreign substance. It has sprouted out from the parent stock, like a sucker from a tree. It may break off after a while and seek an independent resting place, or it may send out a bud from its own stem, which in its turn may do the same, and all may remain attached for some time. While this connection lasts, each member of the compound body forages at his own "will," but the tubes of each connect with the trunk of the next, and so with the parent stomach. Thus they form a colony in which each member helps to maintain every other member by his labor. A sight of such a colony of hydras, the working of which is visible to the naked eye, helps one to understand many other similar forms of animal life—as, for instance, the corals, which form colonies by budding. As many as four generations of hydras have been seen on one stem, so that there is some reason for likening such a community to "a living genealogical tree."

By a number of experiments with which some of us will scarcely sympathize, Trembley and those who have repeated his investigations have brought out many astounding facts about these animals. If you cut one in two across the trunk, the upper part floats off and resumes its voracious habit in a new locality; while the lower portion remains, develops a new set of tentacles, and goes on just the same as if nothing had happened. Nay, you may cut a hydra into five or six pieces, and each will make a separate animal. If one is divided into two vertically, the two halves close up, and again you have two individuals. Trembley succeeded also in turning a hydra inside out, and it was able to catch food and digest it as well as before. The creature, however, insisted on turning itself back again, and this was not what the experimenter wished. He therefore passed a needle through the body, near the mouth, and kept it there.

The method of this Dutch naturalist was very ingenious. Holding the hydra in a little water in the palm of his hand, he induced it to swallow a small worm. He then took a bristle and began to push against the base, working the end of the body upward against the worm, and soon had the animal inverted. Thrusting a needle through the base of the tentacles, he had what he wanted. He says: "I have seen a polyp turned inside out, which has eaten a small worm two days after the operation. I have fed one in this state for more than two years, and it has multiplied in that condition."

Hydras have but low powers of locomotion, but still they can move from place to place. When one wishes to go upon its travels it attaches itself to the surface of its support by a tentacle, and then moves the disk up to the tentacle. In this way it can get over about eight inches in twenty-four hours. It can, however, take a longer journey by attaching itself to the shell of a water snail, and thus travel in a few minutes a greater distance than it could do in a day alone. It can also swim with the disk floating on the surface of the water as if suspended.

Although without eyes and a nervous system, the green hydra is very sensitive to the light, and indeed all seem to be instantly aware of a ray of sunlight. Would it not be curious if it was discovered that the rays which affect sightless creatures, like the hydra, are those about which so much investigation is being carried on?

Many more interesting things might be said about hydras, but these must suffice. I will only add that the more I think about them and the more I see of their habits, the more I realize the truth of the words of Charles Bennet, of Geneva, in Switzerland, about them: "We can only judge of things by comparison, and have taken our ideas of animal life from the larger animals; and an animal we can cut and turn inside out, which we can cut again and it still bears itself well, gives one a singular shock. How many facts are ignored which will come one day to derange our ideas of subjects which we think we understand! At present we just know enough to be aware that we should be surprised at nothing."

A PLANT of a new species—*Bauhinia magalandra*—is described as growing on the island of Trinidad, the flowers of which depend on bats for their fertilization. The bat visits the flowers for the insects they harbor, and, in trying to reach them, disturbs the stamens and shakes the pollen from them.

THE ORIGIN AND DEVELOPMENT OF NUMBER SYSTEMS.

By Prof. EDWIN S. CRAWLEY.

IT is generally acknowledged that we have in the number systems of the lower races to-day a means of studying the development of our own system. This is based upon the assumption that when the savage begins to count he does it always in essentially the same way. This is, in fact, more than an assumption. An analysis of the number systems of many races scattered all over the globe shows that such a similarity exists, and there is no reason to suppose that our own ancestors followed any other method. Indeed, such evidence as it is now possible to bring forward all goes to support this view.

Counting begins when man first forms the idea of *two* as distinct from *one* and *more than two*. We may perhaps go back even one step further, and say that it begins when the idea of one, as distinct from more than one, is formed. If this be taken as the starting point, the distinct conception of two forms the second step. It is difficult to realize that such ideas are not contemporaneous with the birth of intelligence, but there is evidence to show that such is not the case. According to Dr. Charles Letourneau, we have one example of a race which has not yet taken even this first step. He says in his book on Sociology (translated by Henry M. Trollope), page 582: "The Weddahs of Ceylon, who seem to be the least intelligent of men, have still no mathematical faculty whatever; they have no name for any number." To say that they have no name for any number probably does not imply that they are unable to realize that one group of objects contains more individuals than another group of the same objects. They could even determine which of two such groups contained the greater number of objects, by placing in succession one from each group in pairs until all in one group were exhausted. Such a process, however, is not counting, and the race which finds it necessary to resort to such an expedient may fairly be said to have no conception of number as such.

We find other races who have taken only the first two or three steps. These are chiefly the South American forest tribes and the bushmen of Australia. Speaking of these tribes, Edward B. Tylor says (Primitive Culture, London, 1871, Vol. I, page 220): "Five is actually found to be a number which the languages of some tribes do not know by a special word. Not only have travelers failed to get from them names for numbers above 2, 3, or 4, but the opinion that these are the real limits of their numeral series is strengthened by their use of the highest known number as an indefinite term for a great many. Spix and Martius say of the low tribes of Brazil: 'They count commonly by their finger joints, and so up to three only. Any larger number they express by the word *many.*' In a Puri vocabulary the numerals are given as—1, *omi;* 2, *curiri;* 3, *prica,* 'many': in a Botocudo vocabulary—1, *mokenam;* 2, *uruhú,* 'many.'" It is needless to multiply these examples.

The next step in advance in the development of a number system is taken when the fingers and toes are brought in as aids in the art of counting. The advance is now comparatively rapid up to the point where, these means being exhausted, there is no further natural aid conveniently at hand. It is popularly believed that finger-counting represents the very earliest stage of the art, but the existence of tribes who can not count as far as five, as already cited, would seem to be conclusive evidence of a stage which antedates this. The etymological character of the numeral words in most of the known languages points to the same conclusion. Prof. Levi Leonard Conant, in a book recently published under the title The Number Concept, has collected and analyzed a great number of the numeral systems of savage and semicivilized tribes. He says (pages 98 and 99): "Collecting together and comparing with one another the great mass of terms by which we find any number expressed in different languages, and while admitting the great diversity of method practiced by different tribes, we observe certain resemblances which were not at first supposed to exist. The various meanings of 1, where they can be traced at all, cluster into a little group of significations with which at last we come to associate the idea of unity. Similarly of 2, or 5, or 10, or any of the little band which does picket duty for the advance guard of the great host of number words which are to follow. A careful examination of the first decade warrants the assertion that the probable meaning of any one of the units will be found in the list given below. The words selected are intended merely to serve as indications of the thought underlying the savage's choice, and not necessarily as the exact terms by means of which he describes his number. Only the commonest meanings are included in the tabulation here given:

"1 = Existence, piece, group, beginning.
"2 = Repetition, division, natural pair.
"3 = Collection, many, two-one.
"4 = Two twos.
"5 = Hand, group, division.
"6 = Five-one, two threes, second one.
"7 = Five-two, second two, three from ten.
"8 = Five-three, second three, two fours, two from ten.
"9 = Five-four, three threes, one from ten.

"10 = One (group), two fives (hands), half-a-man, one man.

"15 = Ten-five, one foot, three fives.

"20 = Two tens, one man, two feet."

One of the most significant things to be observed in this table is the absence of any reference to the figures in the numerals for 1, 2, 3, and 4. This strongly confirms the view already expressed, that counting began before the use of the fingers as an aid was thought of. The higher numerals, on the contrary, are made up almost entirely of finger-words and their adjuncts. This does not appear in the English translations, but in the original words it is seen at once.

We may say, therefore, that the human race in learning to count passes through three stages. In the first stage the fingers are not used; progress is very slow; no distinct conception of numbers greater than two or three is formed; all beyond this is "many." Indeed, in this stage it is altogether probable that no conception of number, properly so called, is formed at all; that is, the idea of the number of things in a group is not distinctly abstracted from the objects themselves. In the second stage the fingers and toes are used, and counting can be carried as far as ten or twenty, or perhaps, by the use of more than one man, even a little further; but corresponding numeral words are not yet invented, so that counting is by gestures. In the third stage, words or expressions describing the gestures used in the second stage are assigned to do duty as numerals, and in the course of time they become pure numeral words—that is, they are used merely to indicate numbers, the mind no longer thinking of them as describing gestures that once served the same purpose.

The question now arises whether we can find any trace of finger-counting in our own numerals, and whether we can trace the origin of the lower numerals—those in which we should not naturally expect to find a finger origin. Mr. James Gow, of Cambridge, in his Short History of Greek Mathematics, Chapter I, gives some reasons that seem to show that our own Aryan ancestors, like other races, could not at first count beyond three or four, and afterward learned to count on their fingers. His reasons are three, as follows: 1. The words for 1, 2, 3, and 4 show a different grammatical character from the next six. He says (page 2): "The first three are adjectives, agreeing with only casual and partial exceptions (e. g., δύο) in gender and case with the substantives which they qualify. The same might be said of the fourth, but that in Latin *quattuor* is wholly indeclinable. The rest, from 5 to 10, are generally uninflected, and have, or had originally, the form of a neuter singular." 2. The existence of three grammatical numbers—singular, dual, and plural—probably points to a time when more than two was regarded indefinitely as many. 3. The names of the six numerals, from 5 to 10, may possibly be derived etymologically from a hand or finger source.

Mr. Gow's statements with regard to the grammatical character of the words is easily seen to be quite what we should expect. When man first begins to count, the numerals do not represent to him abstract ideas. He does not think of "2," for example, as a mere number, as we do. It represents nothing to him if separated from the group of objects which it is used to describe. The numeral words, therefore, naturally take on the form of adjectives. Later, when his ideas are further developed and he begins to use his fingers in counting, the real idea of number begins to assert itself, and the words used to designate different numbers appear in a more abstract form. The fingers become, in fact, when used thus, real numerical symbols, as much so as written ones, and the mind gradually becomes accustomed to thinking of the number of a set of objects as something which can be considered apart from the objects themselves, and which can be represented just as well by an equal number of other objects differing from the first set in all respects except that of number. Thus the *abstract* idea of number is formed.

Mr. Gow's ideas upon grammatical number seem to me, if they have the significance he claims, to point back still further. As soon as the idea of two or more as distinct from one is conceived, the necessity for a new grammatical form arises. Now, if the number sense were at all developed, the formation of grammatical number ought to stop here; for it would be apparent at once that to have a different grammatical form for every number is impracticable. But we find a distinct inflection set apart to express two, and a new inflection to designate three or more. The existence of this third or plural number would then indicate that the idea of three, or many, as distinct from two corresponds to another step in the development of the number sense. That the process of forming new grammatical numbers went no further then becomes an argument to show that the subsequent number development was more rapid, and the impossibility of making the former keep pace with the latter was realized.

The etymology of the first three or four of our numerals is probably quite beyond our reach. It has already been pointed out that in the selection of words to represent 1 or 2 the savage has such a wide range of objects to choose from that it is very much a matter of chance what he will select. Any concrete object that possesses the essential quality of unity or duality may be impressed into the service. For 3 and 4 the range of objects that will serve his purpose is more limited, but it is still sufficiently large to make it a mere accident what he will use. For example, the Abipones of the Paraguay region express 4 by "toes of an ostrich," and 5 by "*neenhalek*," a five-colored, spotted hide. Nevertheless, some attempts have been made to discover these etymologies.

Below is given a list which includes, besides those for 3 and 4, some etymologies that have been suggested for the higher numerals. I quote from the work of Gow already referred to, page 3, footnote: "The common derivations, taken chiefly from Bopp, are set out in Morris's Historical Outlines of English Accidence, page 110, note. The following only need be cited:

"*Three* = 'what goes beyond' (root *tri*, *tar*, to go beyond).

"*Four* (quattuor) = 'and three'—i. e., 1 and 3.

"*Five* = 'that which comes after' (four), Sk. *pashchât* = after.

"*Six*; Sk. *shash*, is probably a compound of two and four.

"*Seven* = 'that which follows' (six).

"*Eight*, Sk. *Ashtân* = 1 + and + 3.

"*Nine* = *new* = that which comes after 8 and begins a new quartette.

"*Ten* = two and eight."

In commenting on these etymologies Gow says (pages 3 and 4): "When they say that *pankan* and *saptan*, 'five' and 'seven,' mean 'following,' because they follow 'four' and 'six' respectively, they suggest no reason why any other numeral above 1 should not have been called by either or both of these names; so when they say that *navan*, 'nine,' means *new* (νέος, etc.) because it begins a new quartette, they assume a primeval quaternary notation, and do not explain why 'five' was not called *navan*; so, again, when they say *navan* means 'last' (νέατος, etc.) because it is the last of the units, they evidently speak from the point of view of an arithmetician who has learned to use written symbols." The objections offered by Mr. Gow to these etymologies seem to me to be quite valid, with the exception of the last. It is not at all uncommon to find "9" expressed by some such phrase as "approaching completion," the fingers forming the natural scale, and serving the purpose of written numerals. The savage would be therefore in this respect in the position of an "arithmetician who has learned to use written symbols." In the Jiviro scale 9 is "hands next to complete" (Conant, page 61); in the Ewe scale it is "parting with the hands" (ibid., page 92), and in the Chippeway dialect the same numeral is *shangosswoy*, which is akin to *chagissi*, "used up" (ibid., page 162).

The derivations of the last six of the first ten numerals suggested by Gow are as follows: "Their original names appear to have been *pankan* or *kankan* (5), *ksvaks* or *ksvaksva* (6), *saptan* (7), *aktan* (8), *navan* (9), and *dakan* or *dvakan* (10). Some allusion to finger-counting may well underlie these words. Ever since A. von Humboldt first pointed out the resemblance between the Sanskrit *pañk'an* and the Persian *penjeh*, 'the outspread hand,' some connection between the two has always been admitted. . . . So also *dvakan* seems to be for *dvakankan*, meaning 'twice five' or 'two hands'; *dakan* points to δεξιός, *dexter*, δέχομαι, etc., or else to δάκτυλος, *digitus*, *zehe*, *toe*. Thus, whatever original forms we assume for these two numerals their roots appear again in some name or other for the hand or fingers. It is intrinsically probable, therefore, that *pankan* means 'hand,' and that *dakan* means 'two hands' or 'right hand.' It may be suggested here that the intervening numerals are the names of the little, third, middle, and fore fingers of the right hand. Thus, the little finger was called by the Greeks ὠτίτης, by the Latins *auricularis*. This name is apparently explained by the Germans, who call this finger the 'ear-cleaner.' Now, *ksvaks* or *ksvaksva* seems to be a reduplicated form, containing the same root as ξέω, ξαίνω, ξυρέω, etc., and meaning 'scraper.' The name *saptan* seems to mean 'follower' (ἕπ-ομαι, etc.), and the third finger might very well be so called because it follows and moves with the second, in the manner familiar to all musicians. The name *aktan* seems to contain the common root AK, and to mean, therefore, 'projecting,' a good enough name for the middle finger. Lastly, the first finger is known as ἀσπαστικός, *index*, *salutatorius*, *demonstratorius* (= 'beckoner,' 'pointer'), and the meaning probably underlies *navan*, which will then be connected with the root of *novus*, νέος, *new*, etc., or that of νεύω, *nuo*, *nod*, etc., or both. Whatever be thought of these suggested etymologies, it must be admitted that there is no evidence whatever that our forefathers counted the fingers of the right hand in the order here assumed. They may have adopted the reverse order, from thumb to little finger, as many savages do,* and as, in fact, the Greeks and Romans did with that later and more complicated system of finger-counting which we find in use in the first century of our era. If this reverse order be assumed, the numerals may still be explained in accordance with other finger-names in common use, besides those which have been cited. But, after all, the main support of these etymologies is their great *a priori* probability. The theory on which they are based brings the history of Aryan counting into accord with the history of counting everywhere else; and it explains the Aryan numerals in a way which is certainly correct for nearly all other languages. It is hardly to be expected that such a theory should be strictly provable at all points."

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* The order of counting from the little finger to the thumb is, however, the more usual method with savages. See a paper by Lieutenant F. H. Cushing, entitled Manual Concepts, in the American Anthropologist for October, 1892 (vol. v).

Before leaving this part of the subject the writer wishes merely to add that the etymologies suggested above for six, seven, and eight appear to be quite plausible; for *navan*, or nine, however, it appears to him that the association with the idea of "last" is the more reasonable, and would fit in with the finger interpretation of the others just as well as the one suggested.

We return now to the general question of the development of number systems, which we left at the point where men were supposed to have learned to use their fingers and toes as a natural abacus, and to have reached, therefore, the number 20. Before any further progress can be made a scale of notation must be adopted. Of course, this is not done consciously. Within certain limits it is probably entirely a matter of chance what number will be selected as a base. I had better say what number will become the base; for the use of the word "selected" unconsciously implies that the savage exercises a choice, while in fact, as already stated, he is simply led by circumstances. In most cases he has adopted some kind of a base before he has counted as far as 20. We have already seen that one of the commonest forms for "6" is "hand-one" or five-one. When the savage expresses 6 in this way he is committed to a quinary scale. The chances are, however, overwhelmingly against his carrying out this system consistently in all higher numbers, and for very obvious reasons. A pure quinary system of numeration is therefore extremely rare. Nevertheless, at least one such exists, one that is purely quinary as far as it seems to be known; this is the scale of one of the Betoya dialects of South America. In this scale

Six = *teyente tey* = hand + 1.
Eleven = *caya ente-tey* = 2 hands + 1.
Sixteen = *toazumba-ente tey* = 3 hands + 1.
Twenty = *caesea ente* = 4 hands.

(Conant, pages 57 and 140.) It would be interesting to know whether this scale is carried on consistently—that is, whether 25, the square of the base, is recognized as a new starting point, or whether they call it simply "five hands," without any sign to mark it off distinctly from other multiples of the base.

What is generally found in these scales that introduce the quinary element at 6 is that "10" is designated by some expression other than "two fives"; and eleven then becomes 10 + 1; twelve, 10 + 2, etc.—that is, the quinary scale here merges into the decimal; and either we see no more of it, or it continues with the other in a subsidiary place. The latter is the more usual. Thus sixteen is 10 + 5 + 1; seventeen, 10 + 5 + 2, etc. Thus is formed a mixed decimal and quinary scale.

It is a question over which there has been considerable dispute whether all numeral systems were not originally quinary, and the adoption of a larger base came as, with the lapse of time, its superior advantages were recognized. I think that not only is the evidence in favor of the opposite view, but also that from *a priori* considerations we might expect to see the adoption of 10 as a base as readily as 5. It depends, I think, entirely upon whether 6 is called "five-one" or is designated in some other way. In speaking upon this point Prof. Conant says (pages 170, 171): "From the fact that the quinary is that one of the three natural scales with the smallest base, it has been conjectured that all tribes possess at some time in their history a quinary numeration, which at a later period merges into either the decimal or the vigesimal, and thus disappears, or forms with one of the latter a mixed system.* In support of this theory it is urged that extensive regions which now show nothing but decimal counting were, beyond all reasonable doubt, quinary. It is well known, for example, that the decimal system of the Malays has spread over almost the entire Polynesian region, displacing whatever native scales it encountered. The same phenomenon has been observed in Africa, where the Arab traders have disseminated their own numeral system very widely, the native tribes adopting it, or modifying their own scales in such a manner that the Arab influence is detected without difficulty.

"In view of these facts and of the extreme readiness with which a tribe would through its finger-counting fall into the use of the quinary method, it does not at first seem improbable that the quinary was *the* original system. But an extended study of the methods of counting in vogue among the uncivilized races of all parts of the world has shown that this theory is entirely untenable. The decimal scale is no less simple in its structure than the quinary, and the savage, as he extends the limits of his scale from 5 to 6, may call his new number 5-1, or, with equal probability, give it an entirely new name, independent in all respects of any that have preceded it. With the use of this new name there may be associated the conception of '5 and 1 more'; but in such multitudes of instances the words employed show no trace of any such meaning, that it is impossible for any one to draw with any degree of safety the inference that the significance was originally there, but that the changes of time had wrought changes in verbal form so great as to bury it past the power of recovery."

In support of this argument it may be said that at least in the languages of the most cultivated races to-day those elements of their numeral systems which are not homogeneous with the main characteristics of the system show great persistence. The "score" of English is a remnant of old vigesimal counting, and although it has lost its place in the ordinary number system, it is still retained as a semi-poetical form. Still more marked is the "quatre-vingts" of the French. In counting from 61 to 99 they use a purely vigesimal system. If these traces of vigesimal counting still remain, it would seem probable that if the quinary system had ever formed a part of the system it would also somewhere have left its marks, fainter, it is true, on account of its greater antiquity, but still discernible. Now the only indication from a philological source that such a system was ever employed by the Aryan peoples seems to be the Homeric πεμπάζειν (literally to five), meaning "to count." It is sometimes stated also that the form of the Latin numerals I, II, III, IIII or IV, V, VI, etc., implies the existence of an early form of quinary counting. My own opinion is that evidence derived from written numerals, between which and the formation of the numeral system itself there can be no comparison as to dates, can be of very little weight in deciding what was the scale upon which the system was originally formed. If the Roman V for 5 and VI for 6 were adopted because of a quinary element in the Roman scale at the time these signs were first used, surely the spoken language would have retained some marks of the same system. The evidence all points, therefore, with the one exception quoted above, to the nonexistence of a quinary element in Aryan counting.

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* An elaborate argument in support of this theory is to be found in Hervas's celebrated work, *Arithmetica di quasi tutte le nazioni conosciute.*

The third natural scale, besides the quinary and decimal, is the vigesimal. It is doubtful whether a pure vigesimal scale, unmixed with any quinary and decimal element, occurs in any part of the world. In certain regions, or with certain races, a strong tendency is found to make 20 the principal base of the numeral system. This is so with the Celtic peoples, with some Asiatic and a few African tribes, with some of the Eskimos, and with the peoples who formerly occupied the Central American regions. If a tribe counts up to 20, using their fingers and toes, and then continue their counting beyond this point in a consistent way, a vigesimal system will be the natural result; but on account of the practical difficulty of using the toes in any system of gesture-counting, which, as we have seen, is the second stage in the development of the number system, it seems plausible that most tribes confined themselves to the fingers alone. This would account for the greater predominance of 10 and 5 as number bases. It is true that in the case of many well-developed vigesimal scales we have no positive evidence that they originated in the custom of counting on the fingers and toes, but there is certainly great probability that they did all begin in this way. There seems to be no other good reason why 20 should have been adopted for a base. The most perfect examples of vigesimal scales are those of the Mayas of Yucatan and of the Aztecs of Mexico. It has already been mentioned that traces of this system are to be found in our own English numerals and in those of the French. Danish and some of the kindred languages show a strong tendency to vigesimal forms, although, as a whole, the Germanic systems of counting are purely decimal.

Among the important number systems of the world there is one which uses neither 5, 10, nor 20 as its base—namely, the sexagesimal scale of the ancient Babylonians. This system is of special interest to ourselves, for its influence is still felt in the division of our degree into 60 minutes, and the minute into 60 seconds. It seems to have arisen and continued in use side by side with a decimal system, for the monuments furnish examples of numbers which are wholly decimal, others wholly sexagesimal, and still others in which the two systems are combined. It is a question of great interest to know how such a system came to be adopted. It seems reasonable to suppose that it was formed artificially—that is, 60 did not come to be the base of this system by a process of natural development, as 5, 10, or 20 came to be the bases in the systems of other races. In all probability, therefore, it grew up after the decimal system, and may have been invented for the purposes of astronomical calculation, for the Babylonians were famous astronomers in their day. It is not impossible to suppose that its purpose originally was to render the calculations of the astronomers less intelligible to those who were acquainted with only the decimal scale. However that may have been, its use apparently became common. M. Cantor, the German writer on the History of Mathematics, seeks to explain its origin by saying that the Babylonians divided the circle of the heavens into 360 degrees, one degree for each of the 360 days into which they divided the year. They were probably also acquainted with the fact that the chord equal to the radius subtends exactly one sixth of the circumference, or 60 degrees. This may have led to the adoption of 60 as the number base. Prof. John P. Peters, in a letter published in the Proceedings of the Society of Biblical Archæology for May, 1883, pages 120, 121, says, in substance: The use of the fingers of one hand to count to 5 was in some cases extended to 6, by using the open hand with the fingers and thumb extended to express 5, and then indicating 6 by the closed hand. This method, if extended to both hands, gives rise ordinarily to a duodecimal system; and we have abundant evidence both in our own English and in some other languages of the presence of a duodecimal element, which may have arisen in the way suggested. The Babylonians, however, instead of developing a pure duodecimal system, combined the seximal with the decimal in a multiplicative manner, and so developed a sexagesimal system.

The reader may take his choice between these two attempts to explain what, in any case, must be regarded as a remarkable phenomenon. Without denying that either may possibly be the true explanation, the writer is of the opinion that much additional evidence will be required to finally solve the question. With the rapid advance that is now being made in the field of Babylonian antiquities it is not impossible that the needed information will be forthcoming.

IVORY: ITS SOURCES AND USES.

By N. B. NELSON.

THOUGH an animal product, its combinations with wood, particularly *ebony*, from the earliest history, and the similarity of its uses and working in the way of carving, turning, veneering, and inlaying, make ivory an interesting material to joiners, decorators, and builders.

In texture, elasticity, hardness, peculiar markings or cloudings of the grain, and several other particulars, ivory is very like the harder woods, and, being of similar durability, is very suitable to "make up" in mosaics, inlaying, etc., with them, making a companion commodity.

Ivory is really dentine—that substance, not unlike bone, of which teeth principally consist. By usage it is restricted to the dentine of those teeth which are large enough for industrial purposes—viz., the tusks of the elephant, hippopotamus, walrus, narwhal, and some varieties of whales. These forms of ivory differ about as the hard woods differ: the elephant ivory, by its size and quality, is best suited for all purposes; that of the hippopotamus is harder and finer, but owing to its hollowness can only be used for small articles. The old Norsemen used extensively the tusks of the walrus, and when "whaling" was at its best the sperm whale was sought almost as much for the ivory as for the oil. It was the writer's fortune to examine a whale's tooth which was nine or ten inches in length and six or eight in circumference, and seemed solid ivory of a beautiful quality, but so hard as to defy every effort of its owner, who was an expert carver, spoiling, as he expressed it, his "tools and temper."

Ivory, consisting chemically of an organic matrix or growing element, phosphate and carbonate of lime, is permeated by numerous exceedingly fine canals, starting from the organic or pulp cavity and running generally outward to the circumference of the tusk. To the regularity and smallness of these canals ivory owes its elasticity, firmness, and fineness of grain; to their curvatures and eccentric direction—plainly visible in cross-cut sections—are due those beautiful cloudings and delicate markings which give value to, and readily distinguish the real from the imitated article.

Ivory is extremely hard and heavy—the very name, a Latin derivative from *barrus*, an elephant, so called from a Greek word meaning heavy. It is difficult to cut, requiring the sharpest and hardest of tools, but yields readily to the saw, the lathe, the file. Owing to its value, which is so constantly increasing that it now ranks with the "precious" substances, the greatest care is taken to avoid waste in manipulation. The cutting is effected with thin saws. Large plates of veneer have been obtained by the "reciprocating" saw, cutting a spiral shaving round the tusk. There is an account of one thus produced which was forty feet in length and twelve inches wide. Polishing is done by the use of various powders.

Ivory is dead pearly white in color, which sometimes changes with age and exposure to yellow, brown, or black. This natural whiteness is exquisitely delicate, and, as an enthusiast in ivories expresses it, "bears a great resemblance to the brightest tint of the human skin, which latter is the most beautiful hue in Nature." On account of the yellowing with age, there have been many recipes for restoring its whiteness, but none have proved satisfactory. A fortune is in store for the inventor or discoverer of the "happy medium." The opacity and elasticity of old ivory can be partially restored, at least to be useful for some purposes, by boiling in a solution of gelatin.

The existence of statues and of plaques of ivory larger than could be cut from any known tusk, render it probable that ancient workers possessed some method of bending or molding. It can be made flexible by a bath of phosphoric acid, but at the expense of many of its properties. It will also take a variety of dyes without interfering with its polish, particularly if the actual matrix or organic matter is stained.

The tusks of the elephant are an elongation of the upper incisor teeth, which may attain to enormous development; the largest are those of the extinct mammoth; some specimens have been found in Siberia more than twelve feet in length and two hundred pounds weight. There was a noted one of particularly fine quality, weighing one hundred and eighty-six pounds, that was cut up into piano keys.

Among the modern elephants the African possesses the largest tusks, often nine or ten feet in length, and weighing one hundred and sixty pounds each. A pair of African tusks was exhibited in London recently that weighed three hundred and twenty-five pounds, and measured eight and a half feet in length and twenty-two inches in circumference. Think of the muscular strength of head and neck necessary to support such a weight! The importance of these "ivories" in combat is evident by the dread of a "tusker" shown by elephants less favored. They are often broken in fighting, and always show marks of considerable wear. While even captive animals use them for a variety of purposes—e. g., a trained elephant when directed to pull a rope, will take it between his molar teeth and pass it over one of his tusks to get a good purchase. Nothing of less strength and elasticity than ivory could withstand the strain to which it is constantly exposed.

Foreign bodies, as bullets, arrowheads, or spear points, are often found imbedded in ivory. It is not a rare occurrence for the sportsman's bullet, or the native's spear, intended to pierce the elephant's brain, to penetrate the pulp cavity of the tusk and there become encysted or grown over with ivory and apparently have given the animal no trouble; but occasionally the viciousness of a "rogue," or the evident insanity of some unmanageable creature, has proved after death to have been caused by the suffering from inflammation and suppuration consequent upon the presence of a leaden ball in the "nerve of the tooth."

The best ivory is the African, and the finest quality from near the equator. Much of it is brought by natives from the interior to the coast and sold to Arab merchants, while many expeditions are organized by Europeans to go to the interior and collect the stores gathered by the native tribes. It is an extensive commerce. Four thousand pounds sterling, or twenty thousand dollars, is considered a good result for one season's expedition with one hundred and fifty men. Prices differ in different localities. The "portage," or distance from coast, size, condition, care in handling, and weight all affect price.

The African ivory trade is an ancient one, and in mediæval times Marco Polo, who lived from 1254 to 1324, speaks of the ivory traffic in Zanzibar being "astonishing in amount."

The tusks of the mammoth of northern Siberia, or the fossil supplies, are said to furnish almost the whole material of the Russian ivory workers. They are found in extraordinary abundance, and come principally from the neighborhood of the Lena and other arctic rivers and the coast islands. Mammoth tusks are more slender, more curved, and much larger in proportion than those of recent animals. Many have been found in the frozen morasses or in the solid ice, intact and in a beautiful state of preservation, having lain in their air-tight cases for many centuries.

Among the Scandinavians the tusks of the walrus have long been a source of ivory, and of very good quality too. The spirally twisted tusk of the narwhal is the desideratum of the Eskimo hunter. Asiatic ivory is from India and Ceylon elephants, which are rapidly disappearing. America has some fossil deposits and "glacial preserves" of mastodon ivories, but they are more sought for museums and antiquarian collections than for any commercial value.

The uses of ivory are exceedingly varied. The large cuttings are for veneer, plaques, panels, and portraits; then billiard balls, knife, cane, umbrella, and brush handles, piano keys, buttons, measuring rules, mathematical scales, statuettes, caskets, chessmen and draughtsmen, furniture decorations, and an endless variety of ornaments and works of art.

Ivory working is one of the oldest industries. Numerous references occur in the Old Testament which show that the material was regarded as of great value. It was an element in temple decoration, and is often mentioned among the presents to kings, who employed it for regal state. The ancient Egyptians and Assyrians used it extensively.

The excavations of Nineveh, a city that dates nearly 2000 years B.C., have supplied the British Museum with ivories of very great antiquity, many of them in good preservation, and many others tolerably well restored by boiling in gelatin; all show considerable artistic merit and mastery of the material.

Solomon had an ivory throne inlaid with gold—*vide* description in Chronicles; and the throne of Penelope, of about the same date, is said to have been of ivory and silver. Those ancient carvers attained a delicacy and artistic finish that our modern artists may well envy.

The later Greeks and Romans carried this gold-and-ivory and ebony-and-ivory work to a degree of splendor which seems incredible. From their extensive traffic with Persia and Egypt they obtained immense quantities of both Asiatic and African ivories. The Temple of Juno at Olympia contained, among many great works in ivory, the coffer of Cypselus, the bed, the discus, and the statues of Juno, the Hesperides, and Minerva.

The reputation of the great Phidias was based largely on his gold and ivory sculpture. The Minerva of the Parthenon, forty feet high, and the Olympic Jupiter, fifty-eight feet, evidently surpassed anything of the kind known to moderns. The pupils of Phidias made a number of those colossal images, in which the nude parts of the human figure were in ivory and the drapery in gold.

The Romans were equally extravagant; the gates of the Temple of Apollo, built by Augustus, were of this costly material.

Charlemagne had two ivory gates of Byzantine workmanship. The episcopal chair of St. Vitalis, a work of the sixth century, is a fine specimen. Ivory seems to have become scarce in the twelfth century, and bone was largely used for carving, but during the middle ages ivory again became plentiful, and with the renaissance the art of carving reached perfection.

Florence, Flanders, and Germany were great centers. Cellini, Michael Angelo, Raphael, Dürer, and others tried the old-new art. In the seventeenth century there were many celebrated ivorists. Monks in cloisters frequently devoted a life to carving a crucifix; there are several specimens in different museums.

Schliemann, in his excavations at the supposed site of Troy, found many articles of ivory, useful and ornamental. The French town of Dieppe has had celebrated ivory factories since the fifteenth century, and is still extensively in the trade; but it is in the East, and especially in China, that ivory is most highly prized and worked into decorative forms.

No amount of care and patience is considered excessive among the Chinese in this work of ivory-cutting. This is evident in the extremely minute and delicate workmanship of their carved, lacelike trays, while their nests of concentric ivory balls are well known and are reckoned among the puzzles of industry.

The earliest recorded history—we might say prehistoric, the hieroglyphical—that has come down to us has been in carvings on ivory and bone. Long before metallurgy was known among the prehistoric races, carvings on reindeer horn and mammoth tusk, evidence the antiquity of the art. Fragments of horn and ivory, engraved with excellent pictures of animals, have been found in caves and beds of rivers and lakes. There are specimens in the British Museum, also in the Louvre, of the Egyptian skill in ivory carving, attributed to the age of Moses. In the latter collection are chairs or seats of the sixteenth century B. C. inlaid with ivory, and other pieces of the eleventh century B. C. We have already referred to the Nineveh ivories. Carving of the "precious substance" was extensively carried on at Constantinople during the middle ages. Combs, caskets, horns, boxes, etc., of carved ivory and bone, often set in precious stones, of the old Roman and Anglo-Saxon periods, are frequently found in tombs. Crucifixes and images of the Virgin and saints made in that age are often graceful and beautiful. The Chinese and Japanese are rival artists now in their peculiar minutiæ and detail.

Nothing is wasted in manipulating ivory; all dust, shavings, chips, and small pieces are utilized by being converted into gelatin, or ivory black, or artists' pigments; confectioners and *chefs* make use of ivory dust. Owing to the constantly increasing price, many attempts have been made to imitate ivory, but with poor success. Billiard balls and other small articles have been made of celluloid, a combination of gun cotton, camphor, and ivory dust, but none have been satisfactory to the workman, whether carver, turner, or miniature painter.

There are not less than fourteen extinct but only two or three living species of elephants. Like the American buffalo, they are becoming less numerous every year. Though long-lived—some have in captivity lived over one hundred and fifty years—they propagate very slowly, the most slowly of any known animal; the period of gestation is twenty-two months, and but one at a birth, and they are gradually disappearing before the hunter. One writer states that England's imports of African ivory alone average in one year 15,550 hundredweight, worth from £600,000 to £750,000, or between three and four million dollars, and predicts the certain decrease of supply and consequent increase of value of ivory.

THE PARADOX OF DIDEROT.

By M. ALFRED BINET.

HAVING had occasion several years ago to converse on subjects of psychology with a number of comedians, I sought their opinion concerning the "paradox of Diderot," and, finding much in their answers that was instructive, I took them down. I afterward completed the inquiry by questioning several of the actors connected with the Théâtre Français. The subject had been already studied by W. Archer (cited by William James in his Psychology), but I was at the time ignorant of his work. So far as I can judge, I reached the same conclusions as he.

Diderot's Paradox of the Comedian is not a very profound work, but deals in scattered facts of little intrinsic weight, and his arguments are not very forcible.

His thesis is that a great actor must not be sensitive; or, in other words, that he must not feel the emotions he expresses. "Extreme sensitiveness makes poor actors; while absolute lack of sensitiveness is a quality of the highest acting." He sustains this view by six arguments, viz.: we can not repeat emotion at will, but the power is soon exhausted; the age when the comedian is at his greatest is not youth, when he is quick and full of emotion, but after he has had a long experience, when the ardor of his passions has subsided and his head is calm and his spirit self-possessed; certain facts going to show that the performer's real feelings are different from those which he is expressing on the stage; and, finally, his best argument, and the one on which his thesis mainly rests, that one can not do two things at a time.

The actor has to be observant of his playing, to regulate its effects, his gestures, and his exclamations, to see that they are correct, to keep his mind on the scene, to recollect his part. All this critical work is incompatible with sincere emotion. When a person is really moved, when he feels some great woe, while he may indeed sink upon a chair as the actor does in the scene, he does not keep watch of his attitude while falling or think how to make it expressive and harmonious, but gives himself wholly up to his trouble.

The nine comedians whom I interrogated were unanimous in declaring that Diderot's thesis can not be sustained, and that the actor on the stage always feels, in some degree at least, the emotions of his character. I have been told that other comedians are of a contrary opinion—the elder Coquelin professes not to feel anything of the kind; but I have not conversed with M. Coquelin, and can not verify this assertion. Madame Bartet, of the Comédie Française, says, in writing: "Certainly I feel the emotions of the characters I represent, but by sympathy, not on my own account. I am not, indeed, moved before my audience is, but my emotion is of the same kind as theirs, and is only preceded by it. The extent of the emotion varies on different days, and very much according to my moral and physical condition; and to feel nothing, as happens sometimes, but rarely, is very depressing."

Replies from other actors are to a like effect. M. Worms, of the Comédie Française, says that at certain periods when he is playing scenes of passion or tenderness, the eyes of his comrade are moistened, and that those who do not enter into sympathy with their parts are generally themselves without feeling. M. Mounet Sully and his brother Paul Mounet hold that the art of the comedian consists in this very capability of realizing the emotions of his part with the intensity of actual life; and that on those days when he is without emotions he fails to attain the desired power. The power of realization diminishes, however, if the piece is repeated too many times in too rapid succession, as in M. Paul Mounet's case after the fiftieth representation.

It must be admitted that some actors, as, for instance, Sarah Bernhardt, may become such virtuosos in their parts as to become complete masters of their organisms, and produce the emotions at will.

The emotion of a part does not constitute all of it. A character lives in a piece, mingles in its action, and has his interests, ideas, and characteristics—a personality, in short, the development of which depends on the talent of the author. The actor who plays a part, especially one who creates it, should undergo a metamorphosis, and forget his own personality for a few hours, to put on a borrowed personality. Madame Bartet enters so thoroughly into her part that she puts on features not described by the author, but conformable to its character, thus going far toward completing the personality—filling in the outlines—which the author has sketched. M. Paul Mounet says that one can not master a character till he has mastered its reflex actions, its unconscious movements, gait, etc. M. Got tells us that the comedian's great pleasure is the pleasure of metamorphosis, of becoming for the moment in various things the personage he represents. M. Truffier believes that his profession would be in a crude state without the gift of such metamorphoses. He adds that he experiences these metamorphoses more completely in old plays, which take him out of the range of present life, than in those of to-day.

An important fact to be noted is that each actor plays a part according to the sensibility peculiar to him. M. Mounet Sully speaks of a combination of the character of the personage evoked and that of the actor, and observes that no two actors play the same part in the same way. Madame Bartet says that she is not capable of rendering every kind of emotions, and that she represents some categories better than others. Actors usually play parts having a certain degree of agreement with one another, and are liable to fail when they undertake a part of a different type. This restriction of ability is in part of physical origin, but is also largely moral or emotional.

The power of sustaining emotion and the duration of it vary among actors much, as M. Le Bargy has observed, as some horses excel in speed and others in bottom.

As to the exact nature of artistic emotion, Madame Bartet regards it as real in the sense that it produces the same physical effects in the organism as one would feel on his own account. She is oppressed in a scene of continued grief, is transported in another scene, and becomes wearied with the condition, especially when the emotions correspond with those natural to her.

Artistic emotion has, however, the two peculiar characteristics of being always agreeable and of being subject to the will. The answers we have reviewed are very precise. Othere are less definite; and some of the comedians to whom we have applied have simply answered that the factitious emotions inspired by the parts are less intense than real ones; but M. Mounet Sully is of the opinion that the emotion is lived and felt as if it were real.

We come now to Diderot's principal argument, that one can not be moved by emotion and be critical at the same time. Without availing ourselves of the fruits of recent researches on complex consciousness, we will merely refer here to what we have learned concerning the case in hand. M. Got found no difficulty in supposing the combination of the two functions, in dramatic representation or in oratory. M. Le Bargy regards the emotions of the theater as very much like those of real life. When we are sincerely moved on our own account, we nevertheless remain critic and judge; and only in exceptional circumstances, when the passions are very strong and absorbing, do we lose the critical sense. Madame Bartet finds the thesis of Diderot so far correct that an excess of emotion may restrain the actor and paralyze his resources. He must not be dominated by his emotion, but must control it. But to be in emotion while one controls it implies no contradiction; one can duplicate himself in the theater the same as in life. In the highest anger one has within himself something that says, "I am in too great passion, I am going too far, I must not say that." Yet sometimes, notwithstanding that inner voice, we do not stop in time. The same, in substance, exists in the theater. We watch, we judge—we duplicate ourselves.

Regarding the exact nature of this duplication, Madame Bartet says that during the period of preparation she feels the personality of her part taking possession of her till it substitutes itself for her own as to all the interests of common life; in the scene the doubling is very clear, but under control: "I am all the time seeing and hearing myself; I attend my play. I duplicate myself enough to hear the sound and intonations of my words, the succession of my attitudes, movements, and gestures, but not so far that I cease to appropriate them to myself. The duplication is intensified when, instead of playing, I read." The forgetting of personality varies with the nature of the parts and with numerous other circumstances. M. Truffier relates that once he was obliged to play two characters in farce in the evening after the sudden death of his infant son. He played the first piece automatically, but gradually warmed up to the situation, until his second character took possession of him, putting aside the father's grief. It did not extinguish it, but remanded it to a secondary position. Many like observations are known in science, but this is of special interest, because I got it at first hand. Exceptional circumstances are evidently required for the actor to forget his personality wholly. It is an ideal which some pursue but not one in a hundred reaches. We may remark that when the actor incarnates the personage within himself, he ceases to duplicate himself, but becomes another—the personage. The doubling occurs only when the incarnation is incomplete. Furthermore, the relations between the rival personalities are not fixed once for all, but probably vary from day to day, and with the parts. Then the characters of the actors, their moods, and their relations with the audience have much to do with the matter. Madame Bartet says that she communicates directly with the audience, and feels very distinctly whether it is in sympathy with her or opposed to her. "If I feel that I have not gained it over far enough, I make an intense physical effort to accomplish this. At the climax of emotion, the public appears quite indistinct, like a collective mass; but when my part only half possesses me, I discern the slightest movements occurring in the hall. I have a very clear perception of the silence that denotes that the attention of the audience is fixed, as I have also of its wandering."

We come now to the illusion of the theater as it is felt by the spectators. Taine's description of it as something that is alternately excited and destroyed is not sustained by the persons whom I have interrogated, and so little resembles the reality that I suppose it is a purely theoretical and systematic explanation, invented in all its parts, perhaps unconsciously, by one who was nothing less than he was an observer. As I interpret the teaching of observation, we most clearly and curiously perceive the illusion side of the spectacle when we enter the theater after the curtain has been raised, and are still in the lobbies regarding from a distance what is passing on the stage. At that moment we have a very strange impression that the actors are playing false, and all that there is of the conventional in the theater stands out before us. This impression is strongest at the beginning, and is gradually dissipated as we listen and comprehend the piece. Leaving aside this somewhat exceptional circumstance, and describing what the spectator usually experiences at the theater, we may theoretically, after the manner of Taine, distinguish two different states of consciousness in our minds: we are moved by the piece, and are aware that it is a fiction. But these two states of consciousness in the large majority of cases have not each an independent life, and do not take each other's places by turns. Our real experience is a complex, composite feeling, in consequence of which we are captured by the emotions of the piece while still vaguely aware that it is a fiction. There are not two contrary acts of the mind, two antagonistic attitudes, but everything is mingled and fused. There are at the same time, in our minds, an emotion of the spectator, a feeling of the illusion, a critical judgment on the actor's playing and the merit of the piece, and a good many other things.

About ten years ago, when hypnotic experiments in psychology were in great favor, the thought sometimes occurred of transforming the personalities of subjects and giving them parts to play. M. Charles Richet took the initiative in these ingenious transformations. A woman, a mother of a family, was by his suggestion metamorphosed into a general, an archbishop, a ballet dancer, or a sailor, and we are assured that she acquitted herself in her parts with a perfection which the most accomplished actor could not attain. The superiority of these subjects of suggestion, so ignorant in most things, came, it was said, from their sincerity; they believed in the part they were playing, while the actor knows he is an actor. Our inquiry among the world of comedians has not confirmed these theoretical views. In the first place, we are not convinced that an actor of genius would be so inferior to a poor hysteric on whom the same part had been imposed by suggestion; and then this question of sincerity seems to us now susceptible of a very large number of gradations. We can not affirm that an actor plays without believing; it is true that when he has returned to his dressing room and has put away his burden and become himself again, he no longer believes in the personality of his character, although he may still retain a part of it; but in the scene, in the heat of the action, he may be moved on account of this artificial personage. The artistic emotion of the actor exists, it is not an invention; it is lacking in some, while in others it rises to paroxysm. Now, is not emotion an essential element of sincerity? In short, we believe there is no radical difference, only a shade, between the actor and the subject of suggestion.—*Translated and condensed for the Popular Science Monthly from L'Année Psychologique, vol. iii* (*G. E. Stechert, New York*).

SKETCH OF JAMES CROLL.

IN awarding the Wollaston medal of the Geological Society of England to Mr. James Croll in 1872, President Prestwich spoke of the additional value Mr. Croll's labors had in the estimation of the society from the difficulties under which they had been pursued, and the limited time and opportunities he had had at his command. Prof. A. C. Ramsay, accepting the medal for Mr. Croll, said that he was all the more deserving of the honor from the circumstance that he had risen to the place he had among men of science without any of the recognized advantages of scientific training, having won his position by his own unassisted exertions. Mr. Croll indeed pursued the work which he carried to an achievement that marked an era in geology under disabilities and in the face of difficulties that would have deterred and disqualified any but a man of the highest ability and most vigorous energy.

JAMES CROLL was born, the second of a family of four sons, at Little Whitefield, parish of Cargill, Scotland, January 2, 1821, and died in Perth, December 15, 1890. His father was a stone mason, "mild, thoughtful, and meditative, and possessed of strong religious and moral sentiments"; his mother was firm, shrewd, and observing, and gifted with a considerable amount of "common sense." Being afflicted from early childhood with a pain in his head, he was not sent early to school, but was taught at home. He afterward went to the parish school for a short time, but showed little promise of scholarship, and never could acquire an accurate style of reading or become even a moderately good speller. He was withdrawn from school because of family exigencies just at the time he was beginning to have a longing desire for a better education. This had been awakened by the sight in a shop window of the first number of the Penny Magazine, which he bought; and he continued to buy the successive numbers, and read them with zest. Shortly afterward he read Thomas Dick's Christian Philosopher, and was struck with the novelty of the ideas. He then procured other books on physical science, among which was Joyce's Scientific Dialogues. "At first," he says, "I became bewildered, but soon the beauty and simplicity of the conceptions filled me with delight and astonishment, and I began then in earnest to study the matter. . . . Even at the very commencement of my studies it was not the facts and details of the physical sciences which riveted my attention, but the laws and principles which they were intended to illustrate. This necessarily determined me to study the sciences in something like systematic form; for, in order to understand a given law, I was generally obliged to make myself acquainted with the preceding law or conditions on which it depended. I remember well that, before I could make headway in physical astronomy, . . . I had to go back and study the laws of motion and the fundamental principles of mechanics. In like manner I studied pneumatics, hydrostatics, light, heat, electricity, and magnetism. I obtained assistance from no one. In fact, there were none of my acquaintances who knew anything whatever about these subjects." But he had no taste for chemistry or especially for geology, and a suggestion made at that time that he would one day be a professional geologist would have been repelled as incredible. Seeking for an occupation to give him a livelihood, he served an apprenticeship to a millwright and worked for a time as a journeyman, repairing thrashing machines on the estates where they were situated. The conditions of this life were not pleasant, and he applied himself to house joinering, in which he had acquired considerable skill, at Kinrossie, Glasgow, and Paisley. He had when a boy received a hurt on his left elbow, from the effects of which he had never recovered. The wound now began to assume a serious character, and he was obliged to give up the joiner business and find some easier pursuit.

Not having the education, qualification, or taste to be a clerk, he concluded that some sort of occupation in the tea trade might suit him. He went to Perth to see what could be done, and, approaching the city, saw a man distributing handbills. He resolved that if these bills should turn out to relate to tea, he would follow whatever guidance they might afford him. They were the advertisements of a coffee and tea warehouse which had recently been opened in the High Street. He went there, made an arrangement with the proprietor, Mr. Irons, father of his biographer, and in the spring of 1847 opened a shop in Elgin. The situation was congenial to him, and the business gave him opportunity to read. He read Edwards on the Will; was convinced by its reasoning; and in course of time failing to find in any of the writers of contrary opinions to Edwards what he considered effective answers to his arguments, from a sturdy Arminian and sympathizer with the Rev. James Morison, founder of the Evangelical Union of Scotland (now united with the Congregational Union), he became a fixed Calvinist. The tea business had begun to be a paying one, but the condition of Mr. Croll's arm becoming such that he was unable to attend to the shop properly, he was obliged, in order to avoid future loss, to give it up and retire to Perth.

He supported himself for a little while making induction apparatus for the curative application of electricity and galvanism; then, on the persuasion of a friend who had premises to let, engaged in keeping a temperance hotel at Blair-Gowrie. The house was not furnished, and, having no means to buy furniture, he made it while the building was being finished. The hotel business proved unsuccessful, and Croll's next effort was as a canvassing agent for insurance companies, in which occupation he spent four years and a half—about the most disagreeable part, he says, of his life.

About this time Mr. Croll published his first books, which indicated a leaning of his mind toward theological speculation. They were a pamphlet on Predestination, signed "A Moderate Calvinist," and pronounced by the Rev. Dr. Morison "an extraordinary production"; a pamphlet on the Bearing of Geology and Astronomy upon the Creation of the World; and a larger work on The Philosophy of Theism, a thoughtful book, displaying considerable philosophical insight and accumen, which was eagerly discussed by a knot of students who used to meet with the author. The direct object of this work was defined in the preface to be not to prove the existence of God, but to investigate the method to be pursued in order to arrive at a proof of his existence; or, as the author described it to Dr. Morison, the solution of the problem, Given an organic body, to show how it can be rationally proved that its cause must have been a personality endowed with intelligence, will, and sensitivity. The author maintained that a purely *a priori* or a purely *a posteriori* proof of the existence of God is impossible, and that the only way is by a method which combines both elements from experience and *a priori* elements. The Rev. Dr. John Cairns regarded the work as a positive contribution to theistic argument, and said that the author (whose name was not declared) need only to give himself entirely to this topic or any other to secure distinguished success. Five hundred copies of the book were printed, and it paid expenses and returned a small profit.

Notwithstanding it was anonymous, Mr. Croll gained a reputation from this work, which led to his connection, in 1858, with the Commonwealth newspaper, a journal at Glasgow devoted to the advocacy of temperance and social and political reform; a position which, as he was a total abstainer and a strong advocate of temperance and had forsworn the use of tobacco, suited him very well.

After he had worked a year and a half with the Commonwealth, the directors of the Andersonian College advertised for a janitor. Mr. Croll applied for the position, which involved the keeping of the museum and the free run of the libraries, and, obtaining it, entered upon its duties in the fall of 1859. He found it the most congenial position he ever occupied, notwithstanding one of its duties was the disagreeable one, of which no mention is found in his autobiography, of collecting subscriptions from private gentlemen for the support of the institution. "After twenty years of an unsettled life," he says, "full of hardships and difficulties, it was a great relief to get settled down into what might be regarded as a permanent home." But "Why so many changes, trials, and difficulties?" The disability of his arm precluded him from active work and compelled him to make changes of occupation which were not advantageous. But the main cause of his troubles, he confesses, "was that strong and almost irresistible propensity toward study which prevented me devoting my whole energy to business. Study always came first, business second; and the result was that in this age of competition I was left behind in the race." His situation in the college was compatible with study.

Mr. Croll's tastes were nearly evenly balanced between philosophical and theological speculation and the study of physical science, partly to his advantage and partly to his disadvantage; so that, as he observes, when he was engaged in physics he was continually tempted to turn aside into philosophy, and when in philosophy the attractions of physics frequently drew him over, and it was only by strong effort that he could keep in one region of inquiry without passing over into the other. Hitherto he had been engaged for about fifteen years in philosophical and theological studies, the culmination of which was his book on theism. Now the Andersonian Library afforded facilities for physical study that he could not resist, and he began again, where he had left off in former years, with the principle of the transformation and conservation of energy and the dynamical theory of heat. The question of the cause of the Glacial epoch was much discussed among geologists. Without knowing what Herschel and Lyell had written upon the matter, he conceived the change in the eccentricity of the earth's orbit as probably the real cause, and began in 1864 a series of papers of great importance on the subject, setting forth the solutions "which make his name one of the most illustrious in the history" of theoretic geology. They were published in the Philosophical Magazine and the Reader, and were elaborated in the course of ten years in the book Climate and Time. These papers are characterized by Mr. James Campbell Irons, Croll's biographer, as "distinguished by remarkable concentration of thought, joined to a very great lucidity of exposition," and are considered by him in detail in six groups, of which those on Geological Climate and Chronology, Glacial Epoch and Glaciers, and Ocean Currents include the most weighty contributions.

The papers as they appeared attracted the attention of men of science at home and abroad. The Geological Society of Glasgow in 1867 elected their author an honorary associate, and Prof. Alexander Ramsay, chief of the Geological Survey, and Dr. Archibald Geikie, director of the Scottish department of the survey, were so struck by them that Mr. Croll was offered a position in the Scottish service, to be resident surveyor and clerk in the office at Edinburgh. He was well satisfied with his position in the Andersonian College and reluctant to leave it, but besides a larger salary this place offered some other advantages over that, and its duties promised to leave him as much time and strength to accomplish the work of investigation on which he was engaged as the one at Glasgow. He was obliged to submit to a civil-service examination. His knowledge having been acquired in a life of work and not in the formal routine of school, and he being very nervous, he failed on questions of arithmetic, and in English composition. Dr. Geikie nevertheless insisted on having him, knowing his value, and was supported by other eminent geologists; and at last the Lords of the Civil List, in consideration of many special recommendations in his favor and much labor on the part of his friends, were induced, as Lord Kelvin has it, to accept Croll's "great calculations regarding the eccentricity of the earth's orbit and the precession of the equinoxes during the last ten million years as sufficient evidence of his arithmetical capacity, and his book on The Philosophy of Theism and numerous papers published in the scientific journals as proof of his ability to write good English," and he received the appointment. The duties of this office consisted simply in overseeing the various details of the work, and were not physically or mentally laborious; the hours were short and the labor did not produce mental exhaustion. Yet it did not leave him in quite as fresh condition as his work at Glasgow, and he was obliged to be very precise in the regulation of his life. He had early conceived a distaste for geology as involving too much the consideration of details and not giving due prominence to principles, but he had a special interest in the branch which bore upon the object of the particular study in which he was engaged—of surface geology or drift in its bearings on glacial and interglacial periods. He had begun his studies in this department before leaving the Andersonian College, and had made frequent excursions into the country in search of glacial phenomena. These excursions were continued with equal success after he went to Edinburgh; and Mr. James Bennie, who accompanied him on some of them, has left delightful accounts of them and of Mr. Croll, which are published in connection with Mr. Croll's correspondence.

In 1865 Mr. Croll suffered an affection which interfered seriously and permanently with his capacity for mental work. While bent down, assisting in putting a few tacks into a carpet, he felt a kind of twitch in his head. It did not affect his general health or impair his mental energy, but it was followed by a dull pain, which increased if he persisted in doing mental work for any length of time till it became unbearable; and he was never able afterward to keep his thoughts concentrated upon a single point as he had been before. Had it not been for this mishap, he says, all the private work which he was able to do during the twenty years that followed "might have easily been done, and would have been, in the course of two or three years." For a few years prior to the publication of Climate and Time it was with the greatest difficulty that he could manage to put together in one day as many sentences as would fill a half page of foolscap, and the appearance of the book was delayed on that account.

In the published correspondence of Mr. Croll appears a letter to him from Charles Darwin under date of July 19, 1871, stating that "Mr. Youmans [Prof. E. L. Youmans], of the United States, is very anxious to get a series of small monographs written by the most competent English authors on various subjects, to be published in the United States, and I suppose in England. Mr. Youmans is in some way connected with the great firm of Appletons in New York. He has asked me to name some of the most competent men, and I have thought that you would excuse my giving your name and this note as a kind of introduction. I should add that I do not know on what subject he wishes you to write. I do, however, know that some very good judges think highly of his scheme." This note seems to have been given to Prof. Youmans to present to Mr. Croll. Mr. Croll wrote to Mr. Darwin in reply to it that "the gentleman wished me to write a small treatise on Geological Time; but I explained to him that, in the present state of the question, nothing satisfactory could be written on it which would be of any service to general readers. I believe he felt satisfied that the better plan was to let this subject lie over for some time to come." In February, 1872, on motion of Prof. Ramsay, the Geological Society of England awarded the balance of the proceeds of the Wollaston Donation Fund to Mr. Croll "for his many valuable researches on the glacial phenomena of Scotland and to aid in prosecuting the same." In communicating the award to Prof. Ramsay, Prof. Prestwich, President of the society, added, "Mr. Croll is also well known to all of us by his investigation of oceanic currents and their bearings on geological questions, and of many questions of great theoretical interest connected with some of the large problems in geology."

The book embodying the results of Mr. Croll's glacial studies of twenty years—Climate and Time in their Geological Relations; a Theory of Secular Changes of the Earth's Climate—was published early in 1875. It was accepted at once by scientific men everywhere as a work of great importance and of equal merit and interest; and it has not fallen from the position it took then and has held since. Men might controvert some of the author's arguments or dispute his conclusions, but no one was found to deny that it was an honest and able book and a real contribution to knowledge. Honors came to him after its publication from various directions; in the form of personal acknowledgments from the most distinguished men of science in their letters to him, and in the recognition of learned institutions and societies. The University of St. Andrews gave him the degree of LL. D.; the Royal Society of London elected him a fellow; the New York Academy of Science made him an honorary member; and he was chosen an honorary member of the Bristol Natural Society, of the Psychological Society of Great Britain, of the Glasgow Geological Society, of the Literary and Antiquarian Society of Perth, and of the Perthshire Society of Natural Science. He received also the award of the Murchison Fund in 1876 and of the Badow-Jamieson Fund in 1884. His reply to the proffer of the St. Andrews degree reveals the character of the man. He said, "I hope you will not deem it affectation when I say that I do not consider that I have done anything deserving of such an honor, and that I must look upon it more as a reward to a self-taught man for a long and persevering struggle against difficulties than for any possible results which he has as yet been able to achieve."

Having completed Climate and Time, Dr. Croll desired to abandon the study of climatology and physics in order to engage in the investigation of the philosophy of evolution preparatory to a work on that subject which he contemplated. But his book had become a topic of general discussion in which he was obliged to participate, to the extent at least of seeing that his views were correctly quoted and understood; and consequently he still published articles and wrote much in correspondence on subjects treated in it. During the summer of 1880 he suffered a strain in the region of the heart which almost completely disabled him. Making an external application of aconite, under his physician's advice, to the seat of the pain, he lost the power of speech temporarily, and contracted an impediment in utterance which did not disappear for several years. He finally thought it his duty to resign his position on the Geological Survey, and accordingly retired from the Government service in the spring of 1881. Application was made by his friends for a liberal pension, corresponding with the merits of his work, under the superannuation act; but although the Government dealt at the time with considerable liberality with other persons whose deserts were no greater than his, an allowance of £100 from the Queen's bounty and a superannuation allowance of £75 16*s.* 8*d.* a year were all that were granted him; and although repeated applications were made on various aspects of the case, and backed by what would appear to be among the most influential names in the kingdom, no more could be got.

Among the first fruits of Dr. Croll's new studies was the article on Evolution by Force Impossible; a New Argument against Materialism, which was published in the British Quarterly Review for January, 1883. It was a discussion of the question of "What determines molecular motion and force?" and an attempt to prove that force alone, motion alone, or any sort of act alone, that is, undetermined to any particular direction, is unable to account for evolution. If his conclusion were correct, it would follow that Mr. Spencer's theory of evolution by force was absolutely impossible. A copy of this article was sent, with a friendly letter, to Mr. Herbert Spencer, who answered, in substance, that he had not undertaken to deal with the ultimate cause, which he had alleged to be unknowable.

All the papers Mr. Croll had written on climatic subjects since the publication of Climate and Time in 1875 were collected, revised down to date, and republished at the end of 1885 under the title of Discussions on Climate and Cosmology. "This completed his work on geology and physics, and he quietly but deliberately closed his reading and writing on those subjects, which had engrossed his attention for a period of twenty-five years, in which he had earned a world-wide reputation, . . . to turn to his favorite theme of metaphysics; and now he resumed the subject of which he had never lost sight since his earliest manhood."

While engaged in his book on Stellar Evolution, and particularly while preparing an article on the Nebular Hypothesis, Dr. Croll wrote to Prof. Alexander Winchell, of Ann Arbor, for a copy of his book on World Life, which he desired to see before publishing. The new book, Stellar Evolution and its Relation to Geological Time, was published in the spring of 1889. It deals mainly with the prenebular condition of matter.

Dr. Croll was now able to dictate—not to write and hardly to read—only half an hour a day. But he had one thing to do before his life work could be completed—and he accomplished it. This was the publication of his Philosophical Basis of Evolution, a book in which he undertook to state the principle of determinism, which he declared to be the foundation stone of evolution; to examine its relation to Spencerianism and Darwinism, and to prove that "force, matter, and motion can never be determined by force, matter, and motion," reaching the conclusion that "the universe, in all its beauty, joy, and fullness of life, can never be explained in terms of matter, motion, and force; so that the whole process of evolution, natural selection included, evidently points to theism." Although it was largely of a metaphysical character, the author claimed that his main conclusions were, without exception, "deduced from facts or from fundamental principles." Dr. Croll substantially exhausted himself in finishing the manuscript of this book, and the proof sheets were revised with the help of the Rev. Dr. Caird. The publisher hurried the printing of the work, in order that the author might see a copy of it before he died. A bound copy of it was put into his hand, and he examined it with evident pleasure, observing: "My work is now done. I leave the world without a regret save one"—concern for the future support of Mrs. Croll. A few days after he had read to him the favorable review of the London Times. Two days before he died, though very weak and exhausted, he was mentally "as clear and alert as in his best days," and eager to discuss with a friend some of Mr. Herbert Spencer's views.

Dr. Croll was a man of a deeply religious nature, of the strictest orthodox belief, and of a religion the earnestness and intensity of which impressed his neighbors. His correspondence abounds in expressions marking this as one of the most essential elements of his character. His piety seems to have deepened as he grew older, and was never clearer or more emphatic than in his closing days.

Correspondence.

AGE AND SUICIDE.

Editor Popular Science Monthly:

SIR: In Mr. Robert N. Reeves's interesting paper, Suicide and the Environment, Popular Science Monthly for June, 1897, there are several erroneous conclusions, which are, in my opinion, the direct result of false or incomplete statistics. Not long ago (in 1894) I had occasion to gather data from every civilized country in the world while preparing an article on suicide for the New York Medical Record; and, since Mr. Reeves expressly states that his conclusions are based on statistics (he does not introduce them, however, in his paper), I am forced to conclude that his data are false, for it is not probable—nay, it is impossible—that the gentlemen (the majority of them officials and in charge of mortuary statistics), both in the United States and abroad, from whom I, personally and through correspondence, derived my information in regard to the statistics of suicide, could have unanimously erred.

It is not my purpose to discuss all of the propositions in which I differ from Mr. Reeves; I will content myself with one. And you will please pardon me if, instead of introducing my tables in this letter, I refer you to them as they are to be found published in the New York Medical Record of August 17, 1895.

Mr. Reeves says, "The theory that we hold more strongly to life as we approach its natural conclusion is contradicted by statistics, which show that the last half of life exhibits a great increase in the rate of suicide." The conclusion here advanced is, according to my observations, wholly incorrect. According to Morselli, Quetelet, Mayr, and Wagner, the tendency to suicide is greatest at maturity, and *decreases*, after maturity, with increasing age. Of course, there is a great disparity between the number of the middle-aged and that of the aged; yet, when the proportion is properly arranged and the correct average found, it will be observed that the above conclusion holds good throughout the civilized world. In a list of a thousand suicides (I have forty-seven similar lists, gathered from all parts of the world, in which the groups of suicides range in number from two hundred to five thousand, and the periods of time embraced from five to twenty years) occurring in one locality during a period of nearly ten years, the greatest number is between the ages of thirty and forty years; after forty there is a marked decrease. I think that Morselli's average of greatest frequency for the entire world would be slightly above mine (forty-two years), probably forty-five years. This is about what I make it from his tables. According to my tables, there is an increase in the tendency to suicide from fourteen years up to and slightly beyond forty years, and then a corresponding decrease in this tendency as individuals grow older. JAMES WEIR, JR.

OWENSBORO, KY., *June* 5, 1897.

EARLY PRODUCTION OF ALCOHOL.

Editor Popular Science Monthly:

SIR: Prof. Charles E. Pellew's articles on The History of Alcohol in your issues of June and July are very interesting and attract by the amusing illustrations.

Allow me to point out that the figures of alembics ascribed to an edition of the writings of Geber, the Arabian physician of the eighth century, are from the spurious works of this author. Berthelot has shown that the treatises ascribed to Geber, which were published in Latin, French, and German in the sixteenth century, are fraudulent, and that the genuine writings of the Arabian contain far less chemical knowledge than is usually attributed to him. Prof. Pellew is right in stating that the distillation of wine is first mentioned by Albucasis, a Spanish physician, who died in 1107. He might have added that the first definite recipe for preparing alcohol occurs in the Book of Fires, by Marcus Græcus, written in the thirteenth century; in this the volatile liquid is called *aqua ardens*. Very truly yours,

H. CARRINGTON BOLTON.

UNIVERSITY CLUB, NEW YORK,
July 4, 1897.

A CORRECTION.

Editor Popular Science Monthly:

SIR: I wish to call your attention to a paragraph under the head of a Biographical Sketch of William Williams Mather, published in your journal of August, 1896, on page 553, in which a citation is made from an article by Charles Whittlesey upon the personality of the first geologic survey of Ohio. This article I have never seen, but the statement in regard to my association with Prof. Mather is not warranted by the facts.

In the spring of 1838 I went to Chillicothe, and entered in the land office seventeen thousand five hundred acres of coal and iron lands in Jackson and Lawrence Counties. These lands were purchased for some gentlemen in Albany, Jersey City, and Philadelphia, and in which Prof. Mather, Mr. Briggs, and myself shared. These lands were known to be underlaid by coal and to be within the limit of the productive iron belt of that part of the country, being subsequently the great resource in the establishment of the city of Ironton. Subsequently, and after the suspension of the Ohio survey, Prof. Mather did purchase a tract of land upon which he established a furnace. In this venture Prof. Mitchell, the astronomer, of Cincinnati, was associated with Prof. Mather. I never had any interest in the project in any way, and when selling my lands to Mr. Campbell, of the association which founded Ironton, I refused to have any connection whatever with the business enterprise, preferring to part with my property for a moderate price rather than to be connected with any business operation.

Very truly yours, James Hall.

Editor's Table.

"CHRISTIAN SCIENCE" AND SCIENCE.

It seems as if every age must have its fad, and perhaps we should not disquiet ourselves too much about it. Long ago the question was asked why the heathen raged and the people imagined a vain thing. The question, especially the latter part of it, is equally pertinent to-day; and the answer we venture to suggest is, because they like it. It is very sweet to the unregenerate mind to be able, or seem to be able, to fly in the face of facts. Just as there are persons so constituted morally that they are unable to conceive of liberty except as defiance of law, and who, therefore, when they want to feel particularly free, resort to disorderly conduct of one kind or another, so there are those—in much greater number—to whom natural law seems an intellectual tyranny from which any escape is welcome. This we take to be the philosophy of so-called "Christian science," a delusion which to-day is playing havoc with the intellects of thousands of presumably sane and well-meaning persons.

The great beauty and merit of Christian science in the eyes of its devotees is that it affirms the thing that is not and denies the thing that is. It has to make grudging concessions to the law of gravitation and a few other primary conditions of existence. In a kind of a way it admits that certain injuries to the bodily frame may impair activity and even destroy life. That a man can not walk without legs or do much useful thinking without his head are propositions which it has not yet seen its way to combat; but it takes its revenge on the system of visible things by comprehensive denials in a host of matters only a little less indisputable. It scornfully refuses to recognize pain or functional irregularities of any kind. Fevers, indigestions, inflammations, and the whole tribe of maladies which challenge the physician's art have no foundation in reality, and only need to be suitably ignored in order to be put to flight. If Job of old could only have planted himself at the Christian-science point of view, he could have got rid of his boils in short order, and perhaps saved himself from the interminable and not overcheerful discourses of his friends. The great remedy, as recommended to-day in Christian science circles, is not to think about these things at all, and in case you can not *think* hard enough, to send for a Christian-science adept to help you. The adept will then, with cheerful and enthusiastic mendacity, inform you that you haven't any pain, that you haven't any boils, that you haven't any rheumatism or sciatica, or whatever it may be; and if you should point ruefully to the affected part, will exclaim: "Why, that isn't you; that's a mere mass of matter—soulless matter—and you are a soul, a spirit. You ought to rule your matter and not let your matter rule you." This is a point in the proceedings at which the faith of the sufferer is sometimes severely tried. Cases have been known in which, breaking into language neither wholly Christian nor rigorously scientific, the patient has demanded to know why, if that wasn't him—even grammar may be sacrificed in these emergencies—he should be enduring such abominable tortures on account of it; and up to date the satisfactory answer of Christian science to that particular question has not been formulated.

Give people a fad, however, that they thoroughly enjoy and they will make great sacrifices for it, looking pleasant under circumstances which would test the good humor even of a Mark Tapley. Here is where the Christian scientists may sometimes score; for good spirits are certainly both a prophylactic and a remedial agency of no mean value in various physical troubles. This is the one grain of truth in their bushel of nonsense. On the other hand, they do widespread and serious moral mischief by promoting the bad habit of ignoring facts. We have heard of the case of a Christian-science practitioner who, called in to see a child whose head was covered with a herpetic eruption, declared, while looking steadily at the head, that she could not see any eruption. A little girl who by accident had cut her hand at school somewhat objected to having it bound up by the teacher, giving as her reason that her parents were "Christian science." It certainly is lamentable that, in addition to all the other influences which tend to weaken the sense for truth and fact, there should have sprung up a so-called religious society which places a willful blindness to fact at the foundation of its creed and practice. Surely that kind of thing does not need encouragement or cultivation.

Meantime, Wisdom is crying aloud. Science has revealed itself as the helper and guide of mankind, and, in reply to all questioning of its claims, points to the works it has wrought. "They are they," it may say, "which testify of me." The essential and peculiar mark of science is that it ignores no fact. "Hold thou the fact!" might be taken for its motto. It holds the fact, it wrestles with it till it yields a blessing. The individual scientific thinker, honest though he be, may ignore a fact, may turn aside from evidence that ought to command his attention; but, in so far as he does this, he is unfaithful to the mandate of Science. The fact, however, abides: and Science, through some other of her servants, or perhaps later through this very one, will take it up and make it yield its meaning. Science has all truth for its domain, and for that reason there can be but one science. To apply to science such an epithet as "Christian" involves a total misunderstanding of what science is. Science can do no more than investigate *all* truth, nor can it, consistently with its essential nature, do less.

In the matter, however, of relieving human suffering and prolonging human life, what is the record? The record is that since science obtained a secure footing in the world it has been steadily making better conditions of life for mankind; that it has almost extirpated certain diseases and greatly mitigated the virulence of others; that its prophylactic methods in regard to epidemics that used periodically to scourge the most civilized nations are of proved and signal efficacy; and that by the use of anæsthetics and antiseptics it has assuaged an absolutely incalculable amount of human anguish. A writer in a recent number of The Nineteenth Century, describing the progress of medicine and surgery during the last sixty years, quotes an account given by a distinguished physician of his own experiences in undergoing a surgical operation before the days of anæsthesia. The passage is a painful one, but we shall be pardoned, we hope, for reproducing it, as it is very pertinent to the occasion:

"Of the agony occasioned I will say nothing. Suffering so great as I underwent can not be expressed in words, and thus fortunately can not be recalled. The particular pangs are now forgotten; but the black whirlwind of emotion, the horror of great darkness, and the sense of desertion by God and man, bordering close upon despair, which swept through my mind and overwhelmed my heart, I can never forget, however gladly I would do so. . . . Before the days of anæsthesia a patient preparing for an operation was like a condemned criminal preparing for execution. He counted the days till the appointed day came. He counted the hours of that day till the appointed hour came. He listened for the echo on the street of the surgeon's carriage. He watched for his pull at the door-bell; for his foot on the stairs; for his step in the room; for the production of his dreaded instruments; for his few grave words and his last preparations before beginning. And then he surrendered his liberty and, revolting at the necessity, submitted to be held or bound and helplessly gave himself up to the cruel knife."

Less than fifty years ago these were daily experiences; and whence did relief come? From any hocus-pocus speculations upon mind and matter? From any looking away from phenomena and trying to disbelieve them out of existence? No, but from assuming the reality of phenomena, and bringing a material agent to bear on a physical condition. True, theological objections were raised to this new and most beneficent extension of medical science; but it would have taken more theology than was contained in all the catechisms to make the world renounce the new hope thus tendered to it. And now, if further progress is desired, can any sane and honest man doubt the direction in which it is to be sought? What science has done is but an earnest of what it will yet do. All that is needed is a patient following out of her methods—the first of which is a careful measuring and recognition of facts as they are—in order to reach forward to all possible good. We can only trust that many minds now entangled with "Christian science" will work their way to a knowledge and love of true science. If they do, they will gain a sense of intellectual emancipation such as they never before experienced; they will know also of the doctrine that its foundations are in the truth of things, and that its mission is the healing and regeneration of the human race.

THE WORLD AS IT IS.

In these bright summer days, when most of us get glimpses of rural scenery and not a few are privileged to enjoy it for days and weeks together, it would be fitting if we were occasionally to reflect how wonderfully this world which we find so beautiful has become adapted to us and we to it. We are too much accustomed to take the world as it actually exists for granted as something that always has been and that always will be. We are apt to forget that the whole human period is but as a narrow fringe upon the vast space of geologic time, and that the world before the advent of man was a very different world from that in which we live. We talk of the everlasting hills and of the primeval forest, but to the geologist the hills are not everlasting and the forest is but a creation of yesterday. The poet Tennyson has caught the true geological standpoint in the following fine verses of In Memoriam:

There rolls the deep where grew the tree.
  O Earth, what changes thou hast seen!
  There, where the long street roars, hath been
The stillness of the central sea.

The hills are shadows, and they flow
  From form to form, and nothing stands;
  They melt like mist, the solid lands,
Like clouds they shape themselves and go.

The earth, which we find to-day bright with varied hues, vocal with innumerable sounds, rich in fruits and fragrant with odors, lay for an almost incalculable period of time destitute, or all but destitute, of color, soundless save for the noise of wave and tempest, and with no promise as yet of the rich profusion of vegetable and animal forms that now diversify its surface and fill it with the thrill and manifold activities of life. We often speak of man as "the heir of all the ages," but not often, probably, do we pause to realize the significance of the word. We talk of evolution, but seldom make any due effort to grasp the plenitude and grandeur of the thought. These senses of which we have the use, and each of which brings a different world within our ken, whence are they? It seems so natural to see; it seems so natural to hear, to touch, to smell, to taste, that we forget through what slow processes, by what an incalculable number of slight accretions and delicate modifications these wonderful channels of knowledge and sensation have been made for us. We go back through the ages and we come to a sightless, voiceless world. For a period probably as long as all the rest of geological time the only forms of life were protozoa. Sight was developed among the wonderful crustaceans of the Silurian period, but as yet there were no organs of hearing. The first stridulation of an insect wing was heard (if it was heard) in the Devonian age, the birth epoch of the first vertebrates, fishes; but long ages had to pass before the first bee hummed over a flower or the first butterfly fluttered its wings in the sunshine. There were no flowers in the Devonian age nor yet in the ensuing Carboniferous, though in both there was a mighty vegetation.

The earliest birds belong to the Cretaceous period—the classic age of reptiles. They were not songsters, however—far from it; nor were they beautiful to look upon, for they had strong points of affinity with the reptile tribe from which there is reason to believe they were developed. It was not till well into the Tertiary period that birds as we know them began to trill and twitter in the woods. It was in the same period that the mammals began to take masterful possession of the earth. The earliest mammalian forms were not the perfect organisms as regards form or activity with which the modern world is familiar, and many of them had but a comparatively short existence. In the Tertiary period, however, there was a vast outbreak of insect, bird, and mammalian life, and now began in earnest the struggle for existence—that struggle which has carried existing forms of life to so high a point of perfection.

In the Quaternary period appears man. Whence? How? These are questions which it is impossible not to ask, but for satisfactory answers to which we may have to wait a long time. All analogy leads us to believe that man was developed from some humbler form of life. Upon him was bestowed the great and unique gift of a superior thinking faculty, the material organ of which is undoubtedly his brain. Man "looks before and after," and if he also "sighs for what is not," that too is a notable mark of his superiority. Other animals learn from experience, but to man it is given sometimes to anticipate experience. He sees things in their relations, and a relation becomes to him as real as the thing itself. His thought is, therefore, compared with the thought—if we may so characterize it—of the nearest to him of the lower animals, like a higher algebra compared with the processes of a very elementary arithmetic. His senses are not in general keener than those of the lower animals. The latter, indeed, often surpass him in this respect, but what he sees or hears is for practical purposes increased a hundredfold by what he is able to infer therefrom. He knows what to look for over a wide range of possible phenomena, and separates the significant from the insignificant.

So equipped, the human race has entered upon a world already prepared in a wonderful manner for its habitation. Many were the struggles it had to endure in the early ages; but society was formed, and man, by the aid of his fellow-man, triumphed over all his foes—triumphed, at least, sufficiently to perpetuate his race and hand down from generation to generation a slowly bettering inheritance. And now, in these later days, the human individual in a civilized land can look forth on scenes of peace and plenty and beauty. In this advanced stage of the physical world the song of the bird, the hum of the bee, the gleam of the firefly, the colors and odors of flowers, the golden ripple of the cornfields, the tints and flavors of autumn fruits, are his richly to enjoy. He gazes at the clouds, at the stars, at the brimming tide of the ocean, with thoughts that have been widened and strengthened by the mental efforts of a thousand buried generations. If there is any duty, therefore, that is incumbent on the man of to-day it is to know something by his own efforts of the wonderful and beautiful world in which he has so great an inheritance. Not without feelings of love should he gaze on the landscapes which the labors of his forefathers have helped to make beautiful; and not without feelings of reverent interest should he regard the daily play of natural forces in the world around him. We should all be students in our way; it may not be much that we can do, but some little plot or corner of the great field of knowledge we should religiously till, that we may add, if not a sheaf, at least a blade to the harvests which the workers are bringing in.

Who can reflect, however, on the beauty and harmonies of Nature without remembering that human society is far as yet from having reached its perfect harmony! If there is a natural landscape there is also a human landscape; and here the blots are many, so many that it is difficult not to be discouraged at times, even when making full allowance for all the good that society has realized and represents. The man of strenuous mind will not, however, be discouraged. He will acknowledge the existing evil, and will patiently seek out remedies in the storehouse of natural knowledge. Nature duly interrogated will supply the remedy. For the world apart from man she has established the beneficent law of natural selection; for man also she has established that law, but in the heart of the human being she has implanted, as an adjunct to it, the law of justice. The full scope of that law has never yet been adequately understood by any human society; and four fifths of the legislative tinkering that is done by our politicians springs from a simple ignoring of it. We wish most strongly that every man of science, instead of turning away from politics as something most alien to his studies, would make a duty of asking himself this question: What light do my studies throw upon the questions, or some one or other of the questions, that are now most debated in the political world? It may be that the particular facts with which a given man of science deals may have no visible bearing on any question of the day; but what about the scientific methods he pursues—have they no bearing? We are convinced that light must come some day from the direction of science. It is for the men of science to see that they do not fail in their duty in this most important respect.

Scientific Literature.

SPECIAL BOOKS.

In these two handsome volumes* the distinguished Director General of the Geological Survey of Great Britain and Ireland traverses ground once hot with subterranean fires but long since cooled, and traverses, too, a field in science formerly heated by the fires of controversy which have burned themselves out like the ancient volcanoes. Werner's "geognosts," or the Neptunists, as they were dubbed, who in the latter part of the eighteenth century maintained the aqueous origin of basalt, were converted or silenced in the early part of the nineteenth and have left no followers. There are no more Plutonists, moreover, for all geologists are of that stripe. The author has designed this work as a summary of what has now been ascertained regarding the former volcanoes of the British Isles. "The subject," he says, "has occupied much of my time and thought all through life. Born among the crags that mark the sites of some of these volcanoes, I was led in my boyhood to interest myself in their structure and history. The fascination which they then exercised has lasted till now, impelling me to make myself acquainted with the volcanic records all over our islands, and to travel into the volcanic regions of Europe and western America for the purpose of gaining clearer conceptions of the phenomena." The British Isles afford a large and varied body of evidence regarding the progress of volcanic energy in former ages. The geological record is remarkably complete in those islands, and has been very carefully studied. The position of Britain, on the margin of a great ocean basin, is one in which volcanic action is apt to be most vigorous and continuous. Furthermore, denudation has made the extensive volcanic record of this region fully accessible to observation. The proofs of the existence of old volcanoes consist in part of the lavas, agglomerates, breccias, and tuffs erupted from the earth's interior. The walls of the orifices through which these materials have reached the surface are also to be found, but often more enduring than these is the column of hardened material filling the once belching chimney of the volcano. Molten material that does not reach the surface is often intruded from below into vertical fissures, forming dikes, or spreads out in horizontal cavities, forming sills and laccolites. Sir Archibald describes all these kinds of evidence in his early chapters, and then enters upon a description of the ancient volcanic localities of Britain in the order of the geological ages. The Lewisian gneiss in northwest Scotland affords glimpses of probable volcanic activity at the very beginning of geological history, and there is other similar evidence dating from pre-Cambrian times. In South Wales a remarkably varied display of British Cambrian volcanic rocks has been preserved. Coming to Silurian time, we find a singularly complete volcanic chronicle. In Merionethshire, Pembrokeshire, Caernarvonshire, Anglesey, the Lake District, and the eastern parts of Ireland the history of eruptions is unmistakable. During the Old Red Sandstone period groups of volcanoes rose in long lines from the waters of most of the lakes, and threw out lava and ashes over tracts hundreds of square miles in extent. Only the earlier half of the Carboniferous period was productive of volcanoes in Britain, but vast remains of these are to be seen in the puys and plateaus of Scotland and in numerous dikes, sills, and bosses. After the last of the Palæozoic eruptions ages of quiescence elapsed before volcanic activity recommenced in Tertiary time. Remains of Tertiary volcanoes are to be found chiefly in the isles of Skye and Mull and in northeastern Ireland. In summarizing the studies here presented our author calls attention to the distribution of the ancient volcanic eruptions along the western margin of the European continent, thus conforming to the tendency of modern volcanoes to range themselves along continental borders. From Archæan time to the Tertiary volcanic activity was remarkably persistent in the British Isles. It is evident from a study of the British examples that where no fissures existed in the visible part of the earth's crust communication from the internal magma to the surface was effected in hundreds of instances by explosions which blew out an orifice. Besides the manner in which the vents were formed, the kind of materials ejected, the mode of closing of the chimneys, and the manifestations of the final efforts of the volcanic force are all to be read in the grand chronicle of the rocks. Seven colored maps and nearly four hundred figures illustrate the work.

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* The Ancient Volcanoes of Great Britain. By Sir Archibald Geikie, F. R. S., D. C. L., D. Sc. In two volumes. New York: The Macmillan Co. Price, $11.25.

While polar auroras may be classed among the more spectacular phenomena of the heavens, they do not force themselves upon our attention as storms, lightning, shooting stars, and eclipses do. They have been studied only under difficulties, for they do not occur frequently in temperate regions as lightning does, and the time when preparations should be made to observe them can not be foretold as with eclipses. It is interesting to have laid before us, in the latest volume of the International Scientific Series, the knowledge that has been gained in the face of such obstacles.* Much of the popular interest which auroras have aroused is due to the varied and often changing forms that they assume. Their protean shapes have caused people of earlier times to see in them bloody flames, armies in the clash of battle, or furiously riding Valkyries. They may appear as faint lights without defined shape; if more distinct, they are seen to have the form of rays converging upon some point in the sky, or of more or less clearly defined arcs, or of bands which fold over on themselves like a curtain, and are called draped auroras. M. Angot describes many variations of these typical shapes, and presents plates on which some of the most interesting are depicted. The vertical rays of which most auroras seem to be made up move both horizontally and vertically, and as they are usually in constant motion an aurora may readily change from one typical form to another. While the light from most auroras is white, the rays are frequently tinged with yellow, and are sometimes red at the lower extremity and green at the upper. The nature of the auroral light is not established, although the spectroscope and polariscope indicate that it is emitted by luminous gases. It seems probable that a slight rustling or crackling sound accompanies auroral displays, but our author finds no credible evidence of any odor. While many auroras of small extent appear only as local phenomena in high latitudes, others are visible to within twenty degrees of the equator. It seems to be usual for an aurora australis to occur simultaneously with an aurora borealis, notably on February 4, 1872, when the globe, with the exception of an equatorial zone of about forty degrees, was enveloped in polar lights. The periodicity of auroras has been studied with the result of establishing a diurnal and an annual period, and a period of a little more than eleven years. Less exactly determined are the periods of about twenty-eight days, and of about fifty-five years and a half. Those of twenty-eight days and eleven years seem to connect the auroras with sun spots. The relations of the aurora with meteorological phenomena and with terrestrial magnetism have also been investigated. The data obtained from researches on the foregoing questions have given rise to many theories as to the cause of auroras. Our author states several hypotheses that have been made clearly untenable by recent advances of knowledge. One of these is the idea of Mairan that auroras occur when the earth passes through the cloud of matter that produces the zodiacal light, some of this matter falling into our atmosphere and becoming ignited. The reflection of sunlight from particles of ice in the atmosphere is another cause suggested, and still another regards the light as a sort of fluorescence. Our author treats with more respect, although positively rejecting it, the theory first definitely stated by Dalton, that the light is given off from silent electric discharges between the upper and lower strata of the atmosphere, these discharges being conducted through ferruginous dust falling upon the earth from space. He gives also several electric theories, among which he regards that of Edlund as the most satisfactory. Edlund starts from the phenomena of unipolar induction—the production of currents in a metallic sheath surrounding a magnet when the sheath is rapidly revolved. The general phenomena of terrestrial magnetism justify regarding the earth as such a sheath. Electricity, according to this theory, is constantly being carried by molecules of air from the equator to the poles, where it accumulates and from time to time returns to the ground by slow discharges which produce auroras. M.

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* The Aurora Borealis. By Alfred Angot. International Scientific Series, Vol. LXXVII. New York: D. Appleton & Co. Pp. 264, 12mo. Price, $1.75.

Angot concludes with a statement of the plausible but undemonstrable theory recently proposed by Unterweger. To the body of the work is appended a Catalogue of the Auroras seen in Europe below latitude 55° from 1700 to 1890, filling eighty-eight pages. A large part of the data employed in this volume were gathered in Lapland during the winter of 1838-'39 by the expedition on board the Recherche, others are taken from Nordenskiöld's Voyage of the Vega, and still others from a variety of sources which the author indicates. The book will go far toward giving the general reader clear ideas in place of fragmentary notions.

GENERAL NOTICES.

The evolution of special lines of culture is a most interesting study. Tylor's Primitive Culture and Early History of Mankind have been followed by a host of books of a general or a special kind, in which almost everything has been "traced." Curiously, however, there is no serious work upon art evolution—using the term art in its wide sense to include all the fine arts—Tylor's *arts of pleasure.* The book before us, which is the fourth in the Anthropological Series, undertakes to study the Beginnings of Art.* Dr. Grosse holds that in modern savages we may safely hope to find similar crude beginnings to those made by primitive man long ago. He denies our right to draw illustrations from among barbarous or civilized peoples, and insists upon taking them from savages only. In marking out culture stages, he emphasizes the mode of gaining food supply, and considers those peoples only as savages—*Naturvölker*—who depend upon hunting and wild food. There are really few such peoples: the Australians, Andamanese, Bushmen, Fuegians, Botocudos, and Eskimos are about all. From these Dr. Grosse collects his examples of primitive art forms. There are two classes of arts—arts of rest (i. e., plastic and graphic) and arts of motion (i. e., the dance, poetry, and music). The former appear to begin with ornamentation and personal decoration, but real representative art also begins early. The arts of the dance, poetry, and music are usually closely connected in savage life. Not only does Dr. Grosse try to show how the various art forms began, he also tries to show how the art reacts upon the artist; he traces the social influence of arts. This is one of the strikingly original features of the work. The book is a translation from the German; the translator has done his part faithfully. The book is perhaps the best that has so far appeared in the Anthropological Series.

Prof. *Tarr* has not undertaken to make this book* a perfectly balanced treatise by giving each part of his subject just the prominence due to its intrinsic value. He has made a book for a special purpose—the instruction of pupils in high schools—and has proportioned it as he deems best for that purpose. He believes that stratigraphical geology should be, for the most part, left to a more advanced stage than that of the secondary school, and so has included only its main truths and some examples of its evidence here. But with structural and dynamical geology, he says, "the body of fact necessary for elementary understanding is not so great nor so difficult to grasp. The teachings of these truths are illustrated on every hand, and, in fact, some of them are already familiar to the pupil before he enters upon the study. They deal with phenomena in the midst of which we dwell, and hence should become a part of the mental possessions of every high-school pupil." Accordingly, he devotes about three fifths of the volume to the dynamic side of the subject, and gives a hundred pages to structural geology, leaving also a hundred for the stratigraphical division. In the structural portion he gives most attention to describing the minerals and rocks that occur extensively in the earth's crust, and by the use of simple language and many photo-engravings of well-selected specimens he makes their nature remarkably clear. In the dynamical division the processes of weathering, erosion, deposition, stratification, metamorphism, and the formation of mountains, volcanoes, etc., are made clear by the same means. The stratigraphical division probably contains as much material as the pupil is likely to assimilate. It opens with an explanatory chapter on the uses of fossils, then the kind of life that prevailed in each geologic age is described with the aid of figures of fossils and ideal landscapes of the several ages, and the account closes with an outline of the changing geography of the United States from Archæan to Cenozoic time. Throughout the work the author is careful to distinguish important doctrines that are proved from those that remain hypothetical. The volume is printed in large, clear type, and contains two hundred and sixty-eight figures and twenty-five plates, including a colored geological map of the United States.

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* The Beginnings of Art. By Ernst Grosse. The Anthropological Series. New York: D. Appleton & Co., 1897. Pp. xiv + 327, 16mo. Price, $1.75.

* Elementary Geology. By Ralph S. Tarr. New York: The Macmillan Co. Pp. 499, 12mo. Price, $1.40.

His various investigations and writings, extending over a term of years, have well equipped Prof. *Israel C. Russell* with material for making a book on the North American glaciers.* In the volume which he has recently put forth he not only enumerates and describes the glaciers of this continent that have been explored, but he also explains the theory and depicts the behavior of these solid rivers, so that the reader untrained in science may follow him. The glaciers of the Alps, being in a region that is surrounded on all sides by thickly populated countries, have been the most studied. But Prof. Russell points out that "North America offers more favorable conditions for the study of existing glaciers and of the records of ancient ice sheets than any other continent. Of each of the three leading types of glaciers thus far recognized—namely, the Alpine, Piedmont, and continental—North America furnishes magnificent examples." After describing the glaciers of each locality from the Sierra Nevada Mountains to Greenland, our author discusses the climatic changes indicated by the glaciers of North America and the evidence that the great ice sheets are retreating. The how and why of glacier movement, and the life history of a glacier, form the subjects of the two closing chapters. The volume is illustrated with twenty-two plates and ten smaller figures.

"There is perhaps little that need be said prefatory to a work of this character," say the authors of a volume of problems, and for the same reason a description of the work can not be long.* The authors have prepared it in the belief that any text in physics needs to be supplemented by problem work in considerable variety. An introduction contains the tables of physical constants required in working the problems, while tables of logarithms, sines, etc., and a list of answers appear at the end of the volume. The use of directed quantities, graphic methods, averages, and approximations is briefly set forth in several preliminary chapters. The problems are divided among the subjects of mechanics, solids, the behavior of liquids and gases, heat, electricity, magnetism, sound, and light. A few problems have been inserted which can not be satisfactorily worked by other than calculus methods, while here and there graphic methods have been suggested that may be profitably extended by the student. Occasional questions not requiring numerical answers have been asked.

The fourth volume of the American History Series deals with a period of growth. Between 1817 and 1858 the territory of the United States was increased by the acquisition of Florida, Texas, and Oregon.† The population of the older States, pushing toward the west and southwest, made settlements and organized communities in the hitherto unorganized territories. In this task they were largely re-enforced by immigrants from Europe. It was a period also of the growth of pent-up forces, which later produced the outbreak of the civil war.

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* Glaciers of North America. By Israel C. Russell. Boston: Ginn & Co. Pp. 210, 8vo. Price, $1.90.

* Problems and Questions in Physics. By Charles P. Matthews and John Shearer. New York: The Macmillan Company. Pp. 247, 8vo. Price, $1.60.

† The Middle Period, 1817-1858. By John W. Burgess. New York: Charles Scribner's Sons. Pp. 544, 12mo. Price, $1.75.

The question as to the policy of a United States Bank and that of the right of a State to nullify a Federal law were settled in this period. But the slavery question only grew more pressing, the several attempts to adjust it all proving ineffective. Prof. *Burgess* has given us a history of public affairs in this period drawn from original sources. He has made a special effort to shun the bias of prejudice and preconceptions, to refrain from glorifying lawlessness in behalf of whatever opinion it was committed, and to credit men and communities with whatever of integrity and sincerity they actually possessed, instead of rating them as gods or demons, according to their position on some one question. Our author has confined himself to those events which, in his opinion, are significant of our progress in political civilization, and he has hoped to so treat them as to remove the traces of misunderstanding between the North and the South which still linger. He does not attempt to do this by conceding that the South was as much right as the North, but takes the position that the South was in error in secession and rebellion, and must acknowledge its error before complete national cordiality can be established. The volume contains five maps, tables of electoral votes in detail, of cabinet officers, of chronology, of bibliography, and a full index.

Since the days when Redfield and Espy and Ferrel struggled with the larger theoretical questions of winds and storms the advance of the science of meteorology has been remarkable. Its practical applications have not lagged behind, being, in fact, the chief motive for the support that has been given to the study of the science. Until lately little has been done toward popularizing the knowledge that has been gained in this field. In a book now before us Dr. *Waldo*, formerly a professor in the United States Signal Service, has undertaken to give an outline of the science in simple form.* The first of the meteorological elements that he treats is temperature. He tells how the atmosphere gets its heat and how temperatures vary in different places and at different times. This chapter is illustrated by many charts on which the average and the extreme temperatures of the earth's surface are indicated. The variation and distribution of air pressure are similarly treated, and a brief discussion of winds naturally follows. The author considers the moisture of the atmosphere with reference to three steps in the cycle that it passes through—as distributed through the air whether invisible or in cloud and fog, as precipitated, and as taken up again from the earth by evaporation. After briefly calling attention to some optical and electrical phenomena, the author returns to movements of the air, describing first the larger circulatory movements, then the secondary circulation in the form of cyclones and local and miscellaneous winds. There is a chapter on weather predictions—the part of meteorology having most popular interest—and one on climate in general, which is followed by an extended analysis of the climate of the United States. The book is suitable for use as a text-book or for general reading. Its mechanical form is attractive, and it is illustrated with one hundred and twenty-one diagrams and other figures.

Prof. *Johnson* has added to his valuable works on engineering subjects a very complete treatise on structural materials.* In his preliminary chapters he describes the behavior of materials under the several kinds of stress, the matter here given being designed to supplement that usually contained in text-books on applied mechanics. A second division of the work, which the author intends to be read by engineering students if they do not get the information in other ways, deals with the manufacture and general properties of cast and wrought iron, steel, and other metals, lime, cement, brick, and timber. The attention given to the structural properties of wood is a feature of the work. Little accurate information on this topic had been available until the Forestry Division of the United States Department of Agriculture began the systematic study of timber and timber trees some five or six years ago. Prof. Johnson has been intimately connected with these investigations, having had entire charge of the mechanical tests. In the chapter on the characteristics of wood a list of over a hundred timber-producing trees of the United States is given, with a brief description of each and a figure of its leaf and fruit. The part of the volume upon which the author expects the student to put his serious work relates to the methods of applying tests of materials and to the machines employed in testing. This is followed by a group of chapters relating to the mechanical properties of the materials of construction as revealed by actual tests, in which the author expects that selections will be made for students according to the course they are taking. Among the special subjects here treated are the strength of iron and steel wire and wire rope, and the magnetic testing of iron and steel. The volume is illustrated with six hundred and thirty-five figures and diagrams and eleven plates. The author has avoided the use of tables, preferring to arrange in diagrams the data often appearing in tabular form. There are appendices relating to the micrographic analysis of iron and steel, to attempts to secure uniform tests of materials, and to standard specifications for structural steel.

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* Elementary Meteorology. By Frank Waldo, Ph.D. New York: American Book Company. Pp. 373, 12mo. Price, $1.50.

* The Materials of Construction. By J. B. Johnson. New York: John Wiley & Sons. Pp. 787, 8vo. Price, $6.

Our material for the study of infant psychology has received a carefully prepared addition in *The Mental Development of a Child*, by *Kathleen Carter Moore*, issued as a monograph supplement to the Psychological Review (Macmillans, paper, $1). This is a record by a mother embracing the manifestations of activity and of change in her own child, and the conditions under which each action or change was manifested. This material is supplemented by summaries reviewing the mental condition of the child at given periods. The first of these reviews covers all lines of activity; later, when there was more to record, each set of activities is summarized separately. The observations are grouped under the four chief heads Movements, Sensations, Ideas, and Language, and many of them, especially those relating to language, are tabulated besides being described.

The sixth volume of the series in Philology, Literature, and Archæology of the publications of the University of Pennsylvania is devoted to *Researches upon the Antiquity of Man*, by *Henry C. Mercer* (Ginn, $2). The contents comprise descriptions of excavations made and articles found in several localities, and are introduced by a discussion of the chipped stone implements which are the most numerously preserved examples of the handiwork of savage man. The first finds herein described are those made at an ancient argillite quarry and blade workshop on the Delaware River. Here were found one hundred and seventy-four hammer stones, large numbers of "turtle backs" and chips, and a few miscellaneous objects. An account of the exploration of an Indian ossuary on the Choptank River, in Maryland, is given by Mr. Mercer, with a description by the late Prof. Cope of the human bones discovered there, and an examination by R. H. Harte, M. D., of traces of disease in the bones. There are also accounts of explorations of aboriginal shell heaps on York River, Maine, where traces of cannibalism were found; of a rock shelter in the Delaware Valley; and of Durham Cave, in Bucks County, Pennsylvania. The text is illustrated with fifty-one figures and diagrams.

The *Philosophical Society of Washington* has issued a substantial volume as the twelfth in its series of *Bulletins*, containing the publications of the society from 1892 to 1894. The address of Prof. T. C. Mendenhall, as retiring president, on The Uncertainty of Conclusions, and that of G. K. Gilbert, also as retiring president, on The Moon's Face, are included in the contents, and among the more extended papers are The Origin of Igneous Rocks, by Joseph Paxson Iddings; Summer Hot Winds on the Great Plains, by Isaac Monroe Cline: and Mean Density of the Earth, by Erasmus Darwin Preston. Several of the papers are accompanied by views or diagrams. There are obituary notices of eleven members, those of Garrick Mallery and James Clarke Welling being accompanied by portraits.

An elementary text-book on *Electricity and Magnetism* has been prepared by Prof. *Charles A. Perkins* (Holt, $1.10), which, while it acknowledges the impossibility of such a work being up to date, still aims to implant initial conceptions that are in accordance with the best modern theories. A brief introductory chapter on dynamics gives some of the general ideas relating to force which are applied later to the special subject of the volume. The usual topics are taken up, and the language and the amount of mathematics employed adapt the book to college preparatory or freshman year classes. There is a directness and conciseness about the mode of treatment that contrasts with the formal and encyclopedic character of some works of a generation ago, which are still in use. The volume contains one hundred and sixty-five diagrams and figures of instruments.

The contrast between old and new methods in education can not be better illustrated than by comparing an old-fashioned primer with *Our Little Book for Little Folks*, arranged by *W. E. Crosby*. In the latter we do not find an alphabet on the first page, followed by the most mechanical of word exercises, with a few crude black pictures interspersed among them. We have, instead, little sentences in which some words are in vertical script, while others are represented by well-drawn pictures. Some pages are in white on black, as they would appear on a slate or blackboard; some of the lessons consist of verses set to simple music; at intervals through the book are plates on which appear in their natural colors the objects drawn in black and white on the reading pages; there is a frontispiece plate of seven national flags, and a plate at the end on which the three primary colors are shown and the three secondary colors produced by combining the primary; another feature is the many simple outline figures which the child can copy with the pencil or by laying sticks together. If this is not a "royal road" to learning it is at least a flowery path. (American Book Company, 30 cents.)

Those desirous of having a popular volume from the pen of the late *G. J. Romanes* will be pleased with the collection of *Essays* which Prof. C. Lloyd Morgan has prepared (Longmans, $1.75). Prof. Morgan has chosen ten essays which Mr. Romanes had contributed to various English and American reviews, only one of them, that on the Origin of Human Faculty, in Brain, being taken from the pages of a technical journal. Several of the essays deal with psychology, which was the especial field of the author, for example, The Darwinian Theory of Instinct, Mind in Men and Animals, Mental Differences between Men and Women, and Hypnotism, while in those treating of other subjects, as folklore in the essay on Primitive Natural History, hygiene in the one on Recreation, or disease in that on Hydrophobia and the Muzzling Order, the philosophical insight of the man into mental states and operations, and his power of placing his thoughts clearly before the reader are everywhere apparent.

The second and concluding part of the reports secured by the Secretary of the Treasury on the *Condition of Seal Life on the Rookeries of the Pribilof Islands* has been issued as a Senate document. This publication contains descriptions of the condition of the rookeries in 1893, 1894, and 1895, by C. H. Townsend, a similar description for 1895 from an examination made by F. W. True, and an account of the mode of seal hunting practiced by a Canadian sealing schooner, as reported by A. B. Alexander, all of these writers being officers of the United States Fish Commission. All these reports furnish conclusive evidence as to the large proportion of female seals in milk that are killed, the consequent starvation of thousands of nursing pups, and the rapidly progressive reduction in the numbers of seals on the rookeries that is going on. The volume is fully illustrated with maps and photographic views.

The author of *America and the Americans, from a French Point of View*, draws no very flattering picture of our social life and institutions. It has been suggested that he is not a Frenchman at all, but an American who under this convenient disguise tells his countrymen some disagreeable but wholesome truths about themselves. The book is nowhere on the title-page mentioned as being a translation, a fact which seems to favor this view. Whoever the author may be, he shows himself intimately acquainted with the peculiarities and customs of the country he so severely criticises. Evidently a man of culture who knows men and manners on both sides of the Atlantic, he touches with a caustic pen on the less lovable characteristics of our social and political life. He notes down his first contact with our people on the journey from Liverpool to New York, and his impressions of the metropolis on its social side, as revealed in public and private functions. He devotes a chapter to the American business man, one to politics, and one to the newspaper. He pays flying visits to Boston, Concord, Plymouth, Cambridge, and Chicago, the Black Belt, and to various summer resorts. Perhaps the most biting chapter is that on Young America, as indeed the difference in rearing children here and on the other side with its well-known results most forcibly strikes a foreigner. The author dubs our children "young Saxon Bedouins, the most terrible of all *enfants terribles*." The book may not flatter our vanity, but as a fearless criticism on some of the crudities of western civilization it should open our eyes a little more to our own shortcomings. (Charles Scribner's Sons, 1897, $1.25)

The value of Mr. *Frederick J. Brown's* statistical study of *The Northern Movement of the Colored Population* rests, it seems to us, not so much upon any evidence it affords as to a definite or very great movement northward, as upon its explanation of the tendencies of the movements of the negroes. They seem to act very much as the whites do—to go where they can do best, north, south, or to other parts of their own region of residence. They are governed by the prospect of employment, by social motives, and by the promise of good treatment—drawn, not driven, as the author expresses it in one place. A goodly number come north, and goodly numbers go in the other directions (Baltimore: Cushing & Co. Price, 25 cents).

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Fragments of Science.

The Swift's Night Flight.—The curious night flight of the swifts is described in Knowledge by C. A. Witchell: "The sun has set and most of the small birds have retired for the night, though the sparrows are still noisy in the creepers on the house. Most of the swifts are flying low over the meadows, but some are in the sky, and of these a few are chasing others, and performing those magnificent swoops by which it appears that the males drive the females to their nests. Certain it is that the pursuing birds (always acting singly) chase particular individuals, whose course they follow at a greater altitude, but always with the intention of finally descending in a falconlike swoop at the lower bird, who, anticipating the attack, swerves downward and finally plunges headlong. The swishing sound produced by the descending swifts can be heard at a considerable distance. . . . At about forty minutes after sunset (whether in June or July) the group of swifts begins to whirl round and round, like a mob of rooks; but again and again the cluster breaks up in a pursuit and a mad, noisy rush across the sky. Yet the birds are gradually attaining a higher position, and their screaming becomes the less noticeable. Their wings often have a tremulous motion, reminding one of the flight of an ascending skylark. Still, there is no deliberate upward flight, only a succession of swoops and rushes, terminating at increasing distances from the ground. The birds keep fairly together, and not one descends to the houses; but it may be the cluster is joined by another group, coming you know not whence. Dusk is beginning to fall, and even the sparrows are silent, but the cries of the swifts can yet be faintly heard. The birds may now be easily lost sight of altogether, especially if there be no white, fleecy clouds high overhead to throw into relief the whirling black dots in the sky. Now is the time to use a field glass or small telescope, and, having once found the birds with it, to keep them in the field as long as possible. . . . Up and up they go, appearing smaller each moment till even the power of the glass is overcome, and the tiny specks vanish for the night. As you drop your arms wearily you find that the dusk has fallen, the bats are out, and the evening mists are rising; but the swifts must now be nearly on a level with those remote flecks of cloud which, at an immense height, are yet snowy in the sunshine."

The Light of Fireflies.—In experiments on the properties of the light of fireflies, Prof. H. Muraoka used plates of copper, aluminum, zinc, and brass of equal size, separated from the photographic plates on which they were severally laid by a layer of cardboard having a cross-shaped piece cut out of the center; wrapped the whole with three or four thicknesses of black paper, and exposed the bundle to the light of several hundred fireflies. His purpose was to learn whether the light from the insects after filtration through the black paper could penetrate the metals and affect the photographic plate, and to determine the relative transparency of the substances used. To his surprise, the parts of the photographic plate under the cardboard were most darkened, while those under the cross-shaped holes remained clear. The light of the insects seemed to behave very much like ordinary light, but, after "filtration," acquired properties similar to those of the Röntgen or the Becquerel fluorescent rays—properties apparently resulting from the filtration. Further, the filtered rays appeared to exert a peculiar action toward the cardboard—called by the author a suction phenomenon—similar to that of the lines of magnetic force upon iron. The properties of the filtered rays seemed to depend on the filtering substances, probably upon their thickness. They exhibited properties of reflection, but those of refraction, interference, and polarization were not observed, although the author believes that they exist. Their properties, generally, appear to be between those of the ultra-violet and the Röntgen rays. The insects used in the experiments had two or three rows of luminous spots on their under body; but the photographic plates were affected by the whole body as well as by the luminous spots, so that a complete image of the insect was formed when it was put upon the plate, the figure of the luminous part being, however, plainer than the rest.

Dust.—Micro-organisms are the great producers of disease, and dust is the chief carrier of micro-organisms. If there is any one ubiquitous thing, it is dust, and yet, notwithstanding its dangerous contents, it is being continually poked up, so to speak. As soon as the housemaid is up, it is hustled and dusted into the air, so that by the time the family is astir any germ which may have quietly settled in some corner where it could do no harm is floating about in the air, ready to appropriate any convenient and moist resting place, such as the human lungs or a bit of the breakfast, which will shortly carry it into one of the inmate's systems. The street-cleaning department, too, spends much of its energy in simply stirring up the dust about the streets; a little of it is carried off in carts each day, but every particle thus removed has probably been previously stirred up and allowed to settle a dozen times. The carpets and upholstery of modern houses were apparently designed as dust collectors. It is impossible to clean thoroughly a thickly upholstered sofa or chair, and almost as difficult to get a modern carpet or rug clean; these articles always contain more or less dirt, which in the case of the carpet is superficially stirred up at each sweeping. In fact, the reckless way in which house and street cleaning are handled is really appalling. Dusting should always be done with a damp cloth, and carpets cleaned by a closed sweeper well filled with wet tea leaves. The street-cleaning problem is simply a question of water supply. A thorough flushing of the streets once or twice in twenty-four hours offers a simple hygienic and thorough solution.

Pocket Gophers.—The pocket gophers, or *Geomyidæ*, according to G. Hart Merriam's description, are North American animals exclusively, and most at home in the western United States and Mexico. Their whole organization is modified to suit a life underground. They are short-legged, thick-set animals, with no appreciable neck or external ears, and very small eyes. The feet are adapted to digging, the fore paws in particular being very strong and armed with long, curved claws, while the sides of the toes are lined with rows of bristles that prevent the dirt from passing between the fingers. The tail is moderately long, thick, fleshy, usually hairless, and sensitive to the touch. In working under the earth the animals loosen the ground with their upper incisors, while they keep their fore feet in active operation in digging and pressing the earth back under the body, and their hind feet in moving it still farther backward. As the dirt accumulates in its rear the animal turns in its burrow and, bringing its wrists together under its chin, with the palms of its hands held up, forces itself along by its hind feet, pushing the earth outward. All the pocket gophers have external cheek pouches, which are used for carrying food. They are great hoarders, and fill their storehouses with vastly more than they consume. The cheek pouches reach back as far as the shoulder. A captured animal filling its pouches after a meal made motions so rapid that they were hard to observe. If a piece, say of potato, too large to go in the pouch, was given him, he would grasp it with both paws and pry off small bits with his long lower incisors, then raise himself a little on his hind legs and hold the fragment between his fore paws while eating previous to putting away what was left. Small pieces were disposed of promptly; others were trimmed by cutting off projecting angles. The animal has to use its fore paws in passing food from its mouth to the pouches, and in emptying the pouches these paws are used very dexterously.

Ginseng.—This drug, which is frequently spoken of as the panacea of eastern Asia, consists of the roots of *Panax ginseng*, belonging to the natural order *Araliaceæ*, a plant indigenous to China and Japan, but chiefly occurring in Corea and Manchuria. The following account is taken from the Lancet: When full grown, the ginseng plant stands from a foot to a foot and a half high, each stem supporting a single palmate leaf. The flower is purple-colored, and in summer is replaced by brilliant red berries. The roots are gathered at the commencement of winter, and, after maceration in cold water for three days, are placed in covered vessels which are suspended over fires until the contents become hard, resinous, and translucent. The drug then appears in the form of brittle rods, often forked or many-tailed, about the thickness of the little finger and from two to four inches in length. The taste is sweetish and glutinous, recalling, in spite of slight bitterness, that of licorice. The wild plant is the most highly valued, but it is extremely rare, being worth more than its weight in gold. According to the Chinese Times, ten large sticks of ginseng and eight of medium size, weighing collectively nine ounces and one fifth, fetched, including duty, seventeen hundred and seven taels (about seventeen hundred dollars). Ginseng culture in Corea is exclusively in the hands of a few state farmers, and is most carefully supervised. The fields are surrounded by lofty barriers, while in each a watchman, perched on a platform, keeps guard night and day. The seeds are set in ridges, the tender shoots being protected from sun or storm by sheds of thatch or coarse cloth. During the first year or two the seedlings are frequently transplanted. They do not attain to maturity until about the fifth year, and, as a rule, are not culled before the sixth or seventh. The leaves are said to possess emetic and expectorant properties, but the roots alone are employed medicinally, being prescribed as a tonic in every disease that is attended by debility. It is as an aphrodisiac, however, that ginseng is in greatest request throughout the whole of the Orient. It is taken in the form of an extract or decoction, the latter mode being generally preferred. It is usually taken in the morning and at bedtime. From three to five grammes of the root constitute a daily dose, and the exhibition may be continued for a week or more. Several unsuccessful attempts have been made to introduce the drug into Europe.

Pilgrims of the Japanese Alps.—In exploring what are called the Japanese Alps, the Rev. Walter Weston found himself in a region still unaffected by European innovations; a plateau more than a hundred and twenty miles long, surrounded by mountain ridges, and known, on account of its secluded position, as "the island province." The old superstitions prevail there in full force: "Hunters burn candles and pray to the spirit of the crag they are climbing"; a black dog or white paper is a charm against the evil one; and "the drawing of 'a horse rampant' is a recognized prophylactic against smallpox." Until a few years ago women were not allowed to climb beyond a certain limit; and when the wife of one of the mountaineers ventured beyond it she was turned, they say, into a stone. Mr. Weston had the very pillar pointed out to him. But the charm is now broken, and women can climb in security. It is, however, considered sacrilegious to climb a mountain till proper parties have been sent to the top to pray the gods for good weather. The mountains are ten thousand or more feet high, of various geological character, and, being near the sea, command peculiar views. Hodekadaka is granite; Yarigstake, the highest peak after Fujisan, is of brecciated porphyry; and Fujisan, nearly two thousand feet higher than the others, is a crater. No railroad or common road enters the mountain region, though both come near it. Mr. Weston met several "pilgrim clubs"—a sort of Alpine clubs having a more numerous membership and costing less than those of the West. "Every year, before the season commences, they meet and decide by ballot who shall climb the sacred mountains. . . . They also stamp their alpenstocks with the names of the mountains they have ascended." They regard their exercise as a religious one, and as they went up they chanted, "May our six senses be pure, and may the weather on the honorable peak be fine!"

The Longevity of Astronomers.—We take the following from an article under the above title in The Observatory. The longevity of astronomers has often been called attention to. The Herschels, the Cassinis, and others have been notable examples. This is all the more curious, as their vocation necessitates late hours and constant exposure to night air. The following consists, says the writer of the paper, of a portion of a list of the names of well-known men connected with astronomy who have lived beyond the allotted human span of "threescore years and ten." The ages are correct to within a few months:

	Obit.	*Age.*
Fontenelle, Bernard de	1757	100
Herschel, Caroline L.	1848	98
Cassini, Count J. D.	1845	97
Sabine, Sir Edward	1883	94
Mairan, De	1771	93
Somerville, Mary	1872	92
Santini, Giovanni	1877	91
Sharpe, Abraham	1742	91
Long, Dr. Roger	1770	90
Airy, Sir George Biddell	1892	90
Thales	B. C. 550	90
Humboldt, Alexander von	1859	90
Robinson, Rev. T. R.	1882	90
Bouillaud, Ismael	1694	89
Rosenberger, Prof. Otto A.	1890	89
Gautier, Jean Alfred	1881	88
Biot, J. B.	1862	88
Cassini, J. D.	1712	87
Messier, Charles	1817	87
Wallis, J.	1703	87
Brewster, Sir David	1868	86
Halley, Edmund	1742	86
Schwabe, Samuel Heinrich	1875	86
Barlow, Peter	1862	86
Pingre, Alexander Guy	1796	85
Longomontanus	1647	85
Horrebow, P.	1764	85
Whiston, William	1752	85
Pritchard, Rev. Charles	1893	85
Maclear, Sir Thomas	1879	85
Hutton, Dr. Charles	1823	85
Dick, Dr. Thomas	1857	84
Woolhouse, W. S. B.	1893	84
Newton, Sir Isaac	1727	84
Le Monnier, Peter Charles	1799	84
Herschel, Sir F. William	1822	84
Lee, Dr. John	1866	83
Bernouilli, Daniel	1782	82
Troughton, Edward	1835	82
Olbers, Dr. William	1840	82
South, Sir James	1867	82
Le Gendre, Jean	1833	82
Nasmyth, James	1890	82
Eratosthenes	B. C. 195	81
Aristarchus	? B. C. 280	81
Emerson	1882	81
Moestlin, Michael	1631	81
Maurolico	1575	81
Bernouilli, John	1748	81
Kant, Immanuel	1804	80
Lassell, William	1880	80
Piazzi, Joseph	1826	80
Mädler, J. H.	1874	80
De Lisle, Joseph N.	1768	80
Bacon, Roger	1294	80
De La Hire, P.	1718	80

Types of the Unemployed.—Of forty-two men in a German colony for unemployed workingmen, described by Mr. Josiah Flynt in the Atlantic Monthly, mechanics and common laborers were most numerous, while others had been in various occupations, and even noblemen were represented. A third of them were boys and young men, while the majority were between thirty and fifty years of age. Two had been in the United States—one as a labor agitator, while the other had never gone a day without work here, if he wanted it. Other men were in the colony "because they had been unable to find even a bread-and-water existence." They had sought work, always in the large towns, but leaving aside the smaller places, where the farmers were asking for laborers. Most of the old men had trades, "but were too old to ply them satisfactorily." One had come to trouble through politics, another because he was unfortunate in his family life. One, who had indulged a ruthless passion for cruelty and killing, was distinguished for his devout piety. The men expressed their hostility to the church, the monarchy, the army, and the police. Very few of them were out-and-out disbelievers, but nearly all had their own private religious ideas, and were perfectly sincere in stating them. Politically they were revolutionists, republicans, or socialists. They all thought they knew what ailed the world, and what it needed for its regeneration, but it hardly ever seemed to occur to them that they had any personal responsibility in the reforms suggested. They seemed to consider themselves as something aloof from society, justified in making all manner of criticisms, but not required to look into their own failings and sins. Tramps have this same trait. They will talk for hours at a hang-out campfire about what ought to be done to make the world better, and at times with a clearness of perception and earnestness of argument that are unexcelled; but let a little personal introspection or criticism be suggested, "and a silence comes over them like that of the graveyard."

The Bordeaux Vineyards.—As described by C. L. Marlatt, in a report to our Government on wine-making in France, the vineyards of the Bordeaux district extend along the Gironde and Garonne Rivers, and their products are classed and known according to the situation of the plantations or the nature of the soil. The most famous of these tracts, that of Médoc, extends from Bordeaux to the sea and between the rivers and the Landes. This tongue of land, almost a peninsula, is entirely planted with vines, and for a distance of fifty miles and five or six miles in breadth the land is occupied by vineyards. These are separated into small communes, each of which bears some celebrated or ancient name, as Margaux, Saint-Julien, etc., and produces its distinct and well-known brand of wines. The wines vary also according to the vintages, the qualities being affected by variations of seasons. The wines as they are quoted in the market usually bear the name of some château or other. These châteaux, the fame of some of which has become world-wide, are for the most part simply country seats, in which the proprietor resides from time to time. The term château was formerly applied to old manorial residences, and the antique appearance and baronial style of architecture of some of the houses is still suggestive of this association. Oxen are generally used in the rough work of the cultivation of the vineyards, while the more delicate operations are performed by women, who in their neat dresses present a very picturesque appearance among the vines. Some of the cellars in which the wines are stored are very large, and the long rows of hogsheads in them have an imposing appearance. In them the wine is bottled, and stoppered with an especial cork bearing the name of the château. The best wines are kept here for long periods of time, in order to develop the special qualities, coming only with age, which give them their reputation.

Early Writing Materials.—Quintus Curtius is cited by Dr. Bühler, in his work on Indian-Aryan Philology, as affirming that birch bark was in use among the Hindus for writing at the time of Alexander the Great. Its employment began in the northwest, where the extensive birch forests of the Himalayas afforded abundant material, and gradually spread to the other parts of the peninsula. The oldest examples of it, says Mr. A. A. Macdonnell in The Academy, are twists found in Buddhist topes of Afghanistan and in the Bower MS. of the fifth century A. D. According to the testimony of the ancient canonical Buddhist works, leaves, probably those of the palms, were the ordinary writing material of the oldest times. The earliest example is the Horiazi palm-leaf Sanskrit MS. of the sixth century A. D., which is preserved in Japan, and of which the Bodleian Library, Oxford, possesses a facsimile. In northern India, where they were written on with ink, palm leaves ceased to be used after the introduction of paper; but in the south, where the writing was scratched in with a stylus, they are still employed. Paper was introduced by the Mohammedans, and has been very extensively used for manuscripts. The oldest Gujerat paper manuscript dates from the beginning of the thirteenth century. Neither varnished boards, such as are used in Burma for manuscripts, have been found in India, nor leather or parchment, which the regulations against impurity of materials would forbid Hindus from using. Copper plates were early and frequently used for inscriptions. They furnish a curious illustration of the narrowness of the limits of invention, in that they practically all imitate the shape either of the palm leaves or of strips of birch bark.

Arid Yucatan.—The second contribution by Dr. C. F. Millspaugh to the Field Columbian Museum, on the Coastal and Plain Flora of Yucatan, relates to a region peculiar in its biological character, and differing essentially from the surrounding regions, especially in its flora. There all plants have a desiccated appearance, due to their struggle against drought, while in the neighboring areas—Honduras, Guatemala, Chiapas, and Tabasco—the wealth of exuberant vegetation is marked. The difference is brought about partly by orographic features—the other regions having elements of mountain and ridge and large streams of which the Yucatan region is destitute, and its soil and coralline substratum being so porous that whatever rain falls quickly filters into cavities, caverns, and faults beneath the surface. Hence the only residual supply of water available for vegetation is held in the peculiar *sartenejas*, *aguadas*, and *cenotes*. The sartenejas are depressions in the plain, from a few ounces to several hogsheads in capacity, at the bottom of which sufficient marshy soil has been formed to retain such water as falls into them. These soon dry up after the rainy season and their vegetation lies dormant. The aguadas are simply larger sartenejas, usually of circular outline and from fifty to one hundred feet in diameter. They retain stagnant water and maintain a growth of mud plants throughout the year. The cenotes are deep, perpendicular-walled, nearly circular wells, penetrating the floor of the plain and opening into an abundant supply of clear, cool water, saturated with carbonate of lime. They are from a few feet to a hundred yards or more in diameter, and from thirty to two hundred feet deep to the water level, and prove by their frequency and extent that this great plain is as freely watered far below its surface as most countries are above. Mr. Millspaugh's list of plants collected in this region and its islands includes 418 genera and 734 species.

Owl Trees.—It is common knowledge or common supposition that owls nest in the hollows of trees; and since sentiment is turning to regard these birds as beneficial enemies of vermin rather than noxious destroyers of useful things, talk is occasionally heard of protecting and encouraging them —as Sir Montstuart Grant Duff has done. An English writer has been investigating their nesting places, and finds that they prefer pollard elms in which repeated cuttings have caused growths of gnarls and protuberances and all sorts of shapeless hiding places. In one of these trees become a habitation of birds he found the center of the crown forming a kind of platform walled round by the ruins of what should have been branches. The floor of the platform was constituted of rotten wood, leaf mold, and dead sticks, mixed with the bones and fur of "finely pulverized mice." "The bases of the branches, or what should have been branches, were hollow shells, often measuring yards across, with various holes, bulges, knots, and cracks, some piercing the sides, some making only side chambers and shelves. These caverns are the chosen home of the white owl. In one she sleeps, in another she lays her eggs, in a third she has her larder when the young owls are growing up. In another similar tree, if one be near, her husband sleeps by day; and from any one of the doors or windows she slips out and flies noiselessly across the meadow when an intruder scrambles into the crown of the old tree. There is such a labyrinth of passages in the hollow chambers that to find the nest is not easy, even when the place of the bird's exit is marked." The testimony to the service rendered by the owls during the vole plague, given before a parliamentary commission of inquiry, is declared to be sufficient to justify complete protection of them by law.

Chess Players' Vision.—The study of the psychology of the great chess players has given Prof. Alfred Binet opportunity to describe a special form of visual memory which he calls *geometrical*. As represented by the players, the elements of blindfold chess playing are reducible to the three principles of erudition, memory, and imagination. By imagination, corresponding to what psychologists call visualization, they represent to themselves as if they saw them the positions of the pieces on the board. It is not an uncommon faculty, but is developed to a rarely high degree in the chess player; and has the peculiar power of abstracting from the object visualized solely the qualities necessary for the combinations of the game, consisting of the reciprocal positions of the pieces and their motions. The image seen by the player is therefore an image of fixed positions and possible movements; or, a geometrical visual image. A second element of blindfold chess playing is the recapitulating memory, or the faculty of repeating all the movements in the order in which they have been played. Blindfold playing rests chiefly on the exercise of these two memories—the memory of position and the memory of recapitulation. The third element of the play, erudition, comprehends the recent memory of a game. The analysis of it furnishes a good occasion for studying the true character of what may be called the memory of ideas, and the part which former recollections play in the acquisition of new conceptions.

MINOR PARAGRAPHS.

Experiments on the influence of music upon respiration recorded by MM. Alfred Binet and J. Courtier in the *Année Psychologique* for 1897 indicate that musical sounds, chords, and music in general as a sensorial excitation, independent of all suggested feelings, provoke acceleration of respiration, increasing as the movement is more lively, without disturbing the regularity of the breathing or augmenting its amplitude. The major mode is more exciting than the minor. The heart is similarly affected. The distinction between sad or solemn and lively music appears to be for the most part wholly theoretical, and hardly squares with the complexity of the musical emotions produced by the melodies with the infinite shadings suggested by the ideas of the libretto. The authors, however, infer from their researches that the acceleration of the heart and of respiration was not so marked during the hearing of sad pieces as in those in which joy and high excitation of musical emotions prevail.

A novel use is proposed for the pith of cornstalks as a packing between the inner and outer shell of war vessels. When pierced with a projectile it will absorb water and swell so rapidly as to close the opening before the vessel has leaked to a dangerous extent. This quality is under investigation by official commissions of some of the European nations. The by-product of the process of preparation seems to be equally valuable. The outer rim of the stalk ground up is found to make a fine and palatable food for cattle and horses. It is said to compare favorably too with the corn blades, timothy hay, and wheat bran. It also keeps well, and can be uniformly mixed with any ground grain.

Marked preferences for different kinds and altitudes of perching places are shown by different birds. The domesticated pigeon perches almost exclusively on buildings; in fact, the seldom flying domestic fowl takes oftener to trees. Wild pigeons, of course, must needs perch in trees. The Spectator calls attention to the fact that some species are never satisfied unless they occupy the absolutely highest point in the neighborhood. Thus, while the jackdaw will sit on any part from the buttresses to the vane of a cathedral, the stork, the gull, the cormorant, and the falcon always seem uneasy unless perched upon the summit of the building or crag which they choose for a resting place. The Rev. A. Morres writes to The Field giving some observations on the falcons that for many years have made Salisbury spire their haunt. The first year that he saw them one of four peregrines settled on the weathercock, four hundred feet high. On crags and cliffs along the coast seafowl always occupy the highest points. One evening in the autumn of 1893 a cormorant, probably driven inland by a storm, alighted on the arrow of the weathercock on the summit of the parish church spire in Newark-on-Trent, where it remained until morning. For nearly eight weeks it returned each night to its perch upon the arrow, finally disappearing in a November gale. In India the adjutant storks always prefer to stand on the topmost pinnacles of high buildings. Once, when a brick had been left on the highest part of the roof of a house during some repairs, an adjutant was seen to take his stand upon the brick, thus gaining an extra two inches of altitude.

NOTES.

The second session of the Monsalvat School of Comparative Religion (Lewis G. Janes, Director) is to be held at Greenacre, Eliot, Maine, August 3d to September 2d. The purpose of this school is entirely unsectarian, and is described to be to afford opportunity for the scientific study of various forms of philosophical and religious thought under competent teachers. The lectures include courses on the History and Philosophy of Religion and on Christian Origins, by the director; the Vedantic Philosophy and the Religions of India, by the Swâmi Saradánanda, of India; Buddhism, by the Anagáriká H. Dharmapála, of Ceylon; The Philosophy and Religion of the Jains, by Mr. Virchaud R. Gandhi, of Bombay; Zoroaster and the Religion of the Parsis, by Mr. Jehanghier D. Cola, of Bombay; and The Religions of China, by the Rev. F. H. James, missionary. A conference for the comparative study of religions will be held during the last week of the school, at which Rabbi Hirsch, of Chicago, Mr. Gandhi, Edward B. Rawson, of New York, and Mrs. Annie Besant will speak on special subjects.

The Newcastle Daily Chronicle of December 17, 1896, speaking of the trial trip of the torpedo boat Turbinia, built by the Marine Steam Turbine Company, Limited, for the purpose of testing the steam turbine engine of Hon. Charles Parsons, says: "Several most successful runs were made, and the very high speed of 29·6 knots was attained over the measured mile. It is believed that this is a speed greatly in excess of anything that has ever been previously accomplished by a vessel of the small dimensions of the Turbinia, which is only one hundred feet in length, nine feet in beam, and has but forty-two tons displacement when fully loaded." As this was only a trial trip, a still higher speed is anticipated after repeated experiments.

It is stated in Nature that M. Camille Flammarion has recently compiled some meteorological statistics regarding the amount of rainfall in Paris, which disclose the remarkable fact that there has been a gradual increase in the fall for the last two hundred years. The following brief table speaks for itself:

	Mm.
1689 to 1719	485·7
1720 to 1754	409·4
1773 to 1797	492·5
1804 to 1824	503·7
1825 to 1844	507·5
1845 to 1872	522·4
1873 to 1896	557·4

Whether this increase is actually due to more rain or to some such causes as better positions for rain gauges, or more improved gauges themselves, one can not with certainty say, but the amount of increase seems rather to negative this. It would be interesting to have similar data from other Continental cities.

The account of the Proceedings of the National Science Club, at its second annual meeting in January, 1896, is late in reaching us, but it loses none of its interest for all that. The purpose of the club is to promote the co-operation of the scientifically inclined women of the country in research and investigation. Twenty papers were read at the annual meeting by members of the club; meetings were held at the reading rooms, 1425 New York Avenue, Washington, several days each week till May; and an experimental course of lectures was given with much success. All parts of the country are represented in the list of nearly a hundred and fifty members, and Norway and Spain furnish corresponding members. The club has twenty-two sections, five of which are in botany.

In a paper read in the British Association, Mr. W. H. Preece mentioned electrical disturbances in submarine cables which produce mutilation of signals and loss of speed in telegraph working, indistinctness of speech and the presence of extraneous and disturbing sounds in telephones, with reduction of the distance through which speech is practicable, which, he said, were due to electrostatic and electro-magnetic induction and to leakage. The paper explained how these disturbances were detected, measured, and mitigated, defined the conditions that determine the distance through which telephony is possible, and described a new form of cable with which the author proposed to connect England and Germany. With such a cable across the Atlantic, he claimed, treble or quadruple the number of words per hour now practicable might be transmitted with the same weight of material.

Dr. C. Le Neve Foster, her Majesty's Inspector of Mines, while visiting the Snaefell lead mine, Isle of Man, after a recent disastrous explosion there, was, by a series of accidents, exposed to poisoning by carbonic-oxide gas for about two hours, until he was taken out on the verge of death. There were several of the party who had to be taken up one at a time, and he was the last to go. For an hour and a half he recorded notes of his feelings while sinking under the influence of the poison, the last entry giving the time he reached the top. Happily, he recovered. "The world," says Nature, "could ill spare a man with such sterling qualities, and science would grieve to lose an investigator who devoted what seemed to be his last moments to extending knowledge for the 'benefit of others.'" Such heroism would have won immortal fame for a military man.

Prof. Bessey, in the American Naturalist, criticises some recent botanical publications for employing English units of measurements, and urges botanical writers to insist upon the use of metric measures throughout. This would all be very well, but that there are some clear-headed people who insist that our system should not be superseded by any but the best, and who still believe that the metric system has not yet proved itself to be that. If it is really the best, it will work its way without special urging.

Mr. E. P. Martin, of the Iron and Steel Institute, observed at its annual spring meeting, 1897, that American steel makers excel enormously those of Great Britain in the output they obtain from their appliances. They have thus, in spite of the high wages that prevail in America, by working in this wholesale manner brought the cost of production to a very low ebb, so that it is now a question not how much steel British producers should send to America, but how far they can meet American competition within their own boundaries.

Sir Augustus W. Franks, President of the English Society of Antiquaries, who died in May, in his seventy-second year, early developed a taste for mediæval archæology, on which he was a leading authority; became an assistant in the British Museum in 1851, and afterward Keeper of the Department of British and Mediæval Antiquities and of Ethnography, and was subsequently till his death a member of the Standing Committee. His principal discovery in archæology was to distinguish the period of "late Celtic" antiquities. Among his archæological works are Ornamental Glazing Quarries, Medallic Illustrations of British History, and an edition of Kemble's Horæ Ferales, which his additions converted, Nature says, into a standard work.

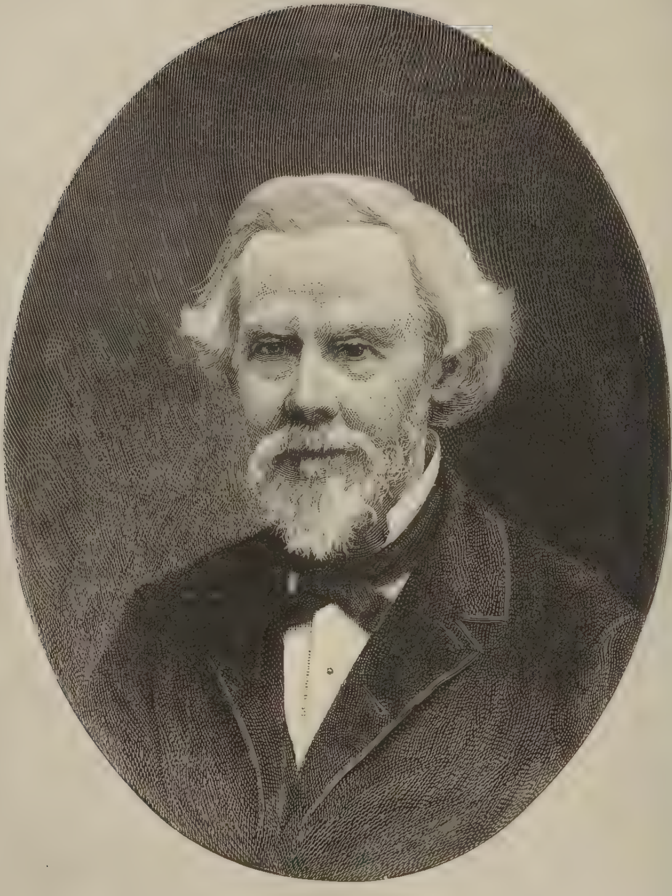
Mr. A. D. Bartlett, Superintendent of the London Zoölogical Gardens, whose death has recently been announced, was originally a hairdresser, and incidentally a bird fancier, specially knowing in canary birds. He obtained a position in connection with the animals at the Crystal Palace, and afterward at Regent's Park. He acquired a remarkable acquaintance with animal life, its habits and diet, and was a skillful appraiser of the value of specimens. With all these accomplishments in zoölogy he was not a writer.

Mr. Edward James Stone, for the past twenty years Director of the Radcliffe Observatory, died in Oxford, England, May 9th, aged sixty-six years. Previous to assuming charge of Radcliffe Observatory he had been her Majesty's Astronomer at the Cape of Good Hope. His special field was the "astronomy of position," and his reputation was mainly won by devotion to meridian observations. He studied the constants of nutation and refraction, the proper motions of the stars, the systematic differences between stellar catalogues, the motion of the solar system in space, and the sun's parallax; and contributed much to the organization of the various astronomical expeditions to the southern hemisphere. He had been President of the Royal Astronomical Society, and held other relations to several learned bodies.

The death is announced at Gothenburg, Sweden, of Baron Oscar Dickson, the wealthy merchant who helped equip Nordenskiöld's first (1868) and bore the entire expense of his second arctic expedition (1872–'73). Baron Dickson was also a large contributor to the expeditions of 1875, 1876, and 1877.

Matthew Carey Lea, who died in Philadelphia on March 15th, devoted himself especially to the study of the chemistry of photography, and particularly to the action of light, etc., on the salts of silver, and published in 1887 a paper on the Identity of the Photo-salts of Silver with the Material of the Latent Photographic Image. He discovered and described three allotropic states of silver. He was a frequent contributor on this and related subjects to the American Journal of Science, had published fifty-four "more important" papers when elected to the National Academy of Sciences in 1892, and issued in 1868 a Manual of Photography, which reached a second edition in 1871.

The deaths are announced abroad of Julius von Sachs, the distinguished botanical author, and of the veteran chemist, Fresenius.



SAMUEL LOCKWOOD.

APPLETONS'
POPULAR SCIENCE
MONTHLY.

SEPTEMBER, 1897.

SPANISH EXPERIMENTS IN COINAGE.

By HENRY CHARLES LEA.

MUCH instructive research has of late years been devoted to the history and inevitable results of paper inflation. The French assignats, our own continental money, colonial overissues, and the practically irredeemable currency of the banks of some of the States prior to the civil war have furnished subjects for elaborate discussion and have yielded their appropriate warnings; but I am not aware that the most remarkable and significant of all attempts to create and sustain fiat money has ever received the attention which is its due. I term it the most remarkable because it was made with coin and not with paper, and the vitiated currency was comparatively small in amount, because it was carried on for more than two centuries with true Spanish persistency, and because it permanently and disastrously affected the destinies of a great nation. Many causes contributed to the decadence of Spain, but, after the expulsion of the Jews and Moors, none perhaps did more to destroy its industry and commerce than its vicious currency legislation. The story is a long one, and I can here touch only on its more salient points. If some of the measures adopted should seem incredibly violent, it must be borne in mind that they were the devices, not of rude and unlettered savages, but of the best trained and most experienced statesmen of the land vainly seeking to escape the consequences of the first fatal step in the wrong direction. The lesson taught is the more impressive from the fact that, in the sixteenth century, Spain was by far the richest and most powerful state in Europe, practically owning Italy through her hold on Naples, Milan, Sicily, Sardinia, and Corsica, and mistress of the wealthy provinces of the Netherlands. She, moreover, enjoyed the monopoly of commerce with the New World and its stores of precious metals; and this enormous power, military and financial, was wielded by an absolute monarch who combined the legislative and executive functions unhampered and unrestrained. If ever a successful attempt could be made to overcome the self-acting laws which govern trade it could be made by Philip II and his successors.

Like all other mediæval kingdoms, Castile had had ample experience of the evils of an uncertain standard of value. In the latter half of the fifteenth century the feeble Henry IV, among other devices to secure the allegiance of faithless magnates, parted freely with the right to coin money, until there were about a hundred and fifty private mints scattering their issues throughout the land. The crown itself reduced the standard of gold coin to 7 carats, while the irresponsible private coiners debased it to whatever their cupidity dictated. When Ferdinand and Isabella came to the throne their resolute sagacity speedily put an end to this deplorable condition. In their final legislation the gold standard was fixed at 23¾ carats; that of silver at the one traditional in Spain known as 11 *dineros* and 4 grains, equivalent to 0·925 fine. The marc, or half pound, of gold, containing 4,608 grains, was worked into 65⅓ *excelentes* or ducats, also known as *escudos* or crowns. The marc of silver was worked into 67 *reales* or ryals. The monetary unit was the *maravedi*, of which there were 34 to the ryal and 374 to the crown, there being thus 11 ryals to the crown. For convenience in small transactions there was an alloy known as *vellón*, consisting of 7 grains of silver to the marc of copper, the marc being worked into 192 *blancas*, the blanca being half a maravedi, and the value of the marc of alloy and the cost of coinage being reckoned at 96 maravedis.*

In 1537 Charles V reduced the standard of the gold crown to 22 carats and its weight to 68 to the marc, diminishing its value to 330 maravedis, which he says brought it to an equality with the best coinage of France and Italy. In 1552, moreover, he reduced the silver alloy in the marc of vellón from 7 to 5½ grains, giving as a reason that there had been a profit in the exportation of the

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* It will perhaps facilitate the comprehension of the Spanish coinage to remind the reader that the *peso* or *real de á ocho*, the "piece of eight," containing 8 ryals, is the Spanish dollar, adopted as our monetary unit by act of Congress in 1786. The ryal is thus one eighth of a dollar, or 12½ cents, well known to the older generation, when our silver currency was almost exclusively Spanish or Mexican, as the "ninepence" of New England and Virginia, the "shilling" of New York, and the "elevenpenny bit" shortened to "levy" in Pennsylvania, or to "bit" in the West and Southwest. Our "quarter" was the two-ryal piece or *peseta*, and the "pistareen," which rated at 20 cents, was the similar coin of an inferior currency, which, as we shall see hereafter, was known as "provincial."

The maravedi, as the thirty-fourth part of the silver ryal, was equivalent to nearly three eighths of a cent.

blancas, rendering them scarce at home. Thus far there had been no serious tampering with the currency, but not long after this, in 1566, the necessities of Philip II led him to seek relief in debasing the minor coinage. It is true that he was the richest monarch in the civilized world; that, besides his revenues from his European dominions, the crown claimed twenty per cent of all the precious metals mined in the Indies and ten per cent seigniorage for minting the rest; but the Venetian envoy Paolo Tiepolo tells us in 1565 that his expenditure for interest alone was 5,050,000 ducats per annum, which, when capitalized at eight per cent, amounted to 63,000,000 ducats of indebtedness—a sum incredible even to the Italian financiers of the period. He had little scruple as to the means of alleviating the burden. In 1559 he had experimented with methods suggested to him of issuing money falsified with a certain powder combined with quicksilver, which when rubbed over copper gave it the semblance of silver, and was proof, as we are told, against the touchstone and the hammer, but not against fire. One inventor of this promising scheme, named Tiberio della Rocca, lost Philip's favor through a quarrel with the royal confessor; another one, a German named Peter Sternberg, was more fortunate, and secured payments amounting to 2,000 ducats for his discovery; but, although every effort was made to keep the matter secret, the Córtes got wind of it, and their remonstrances forced the abandonment of the scheme.

Compared with this wholesale fraud, an enlargement of the token coinage of base metal might well seem harmless, and it is a striking proof of the dangers attendant on any vitiation of the currency that consequences so deplorable and so lasting should have sprung from a source apparently so trivial. In 1566 Philip ordered the coinage of a new alloy, to be known as *moneda de vellón rica,* with a larger proportion of silver—98 grains to the marc of copper, or about $\frac{1}{47}$. The çoins were all small: *quartillos,* 80 to the marc, to be current for a quarter of a ryal (about three cents); *quartos,* 170 to the marc, worth four maravedis (about a cent and a half); and *medios quartos,* 340 to the marc, worth two maravedis. At the same time the old blancas, two to the maravedi, were retained, but the silver alloy was reduced to four grains in the marc; and the number to be worked from the marc was increased to 240, augmenting the profit on every marc by a ryal and a quarter. What amount of this new vellón coinage was poured forth from the mint we have no means of ascertaining, but there can be little doubt that it was as great as the rude mechanical facilities of the age were capable of producing, for Philip's necessities were ever growing, what with the construction of the Escurial, the perpetual drain of the Flemish revolt, the maintenance of the religious wars in France, the conquest of Portugal, the crusade which brought the triumph of Lepanto, the collapse of the Armada, and other ceaseless efforts, prompted by zeal for the faith and thirst of aggrandizement. Yet the infiltration of the currency with these little debased coins was a slow process, and its effects were correspondingly deferred, but they manifested themselves at last, and the *calderilla*—as this coinage came to be popularly designated—grew to be a load which the ablest statesmen of Spain for a century vainly endeavored to shake off. Apparently the process of manufacture became too slow to supply the increasing wants of the treasury, for we hear in 1602 of a restamping of the vellón coinage, doubtless to give it an increased fictitious value. At the same time Philip III made a new issue of pure copper, to the amount of 2,448,000 ducats, working 280 maravedis to the marc, the cost of metal and coinage being only 80 maravedis. Prices rose, and there was general discontent, voiced by the learned historian Mariana in a tract on the coinage written with so much vigor that it cost him an imprisonment by the Inquisition. Thus the reservoir became filled to overflowing, and the inevitable depreciation commenced. To arrest it Philip III, in 1619, solemnly decreed that there should be no more vellón money coined for twenty years; but financial promises of this nature are made to be broken, as is witnessed by Philip IV, in 1632, renewing the pledge conditionally for another twenty years. In spite of these promises, the vellón fell to a discount. There was no formal suspension of gold and silver payments; the silver fleet from Mexico and the galleons from Tierra Firma yearly poured into Spain the treasure won from the mines of the New World; but all the power of an autocratic sovereign could not maintain the parity of the currency. The inequality became so firmly established that it had to be recognized, and Philip IV, in 1625, endeavored to regulate it by a decree permitting a difference of ten per cent. Beyond this any transaction entailed on the receiver, for a first offense, the forfeiture of the principal with a fourfold fine, applicable in thirds to the informer, the judge, and the fisc; for a second offense, the same, with the addition of six years' exile. At the same time it was enacted that no one could demand gold or silver who had not given them, and no obligation to pay in gold or silver was lawful unless gold or silver was lent. These provisions show that already the vellón coinage had risen from its function as a token currency in petty dealings, and was rapidly becoming the standard medium of exchange in all commercial transactions. It is as such that we shall have henceforth to consider it, and it is to this that it owes its importance.

The situation was growing insupportable. Commerce and industry were equally stagnant. No land in Europe had greater resources than Spain in the fine wools of Castile, Aragon, and La Mancha; the flax and hemp of Asturias, Catalonia, Galicia, and Leon; the excellent silk of Murcia and Valencia; the iron, steel, and timber of Navarre, Guipuscoa and Biscay; the wines and fruits of Andalusia; but these were all exported as raw materials, and though the trade of the Indies was a jealous monopoly, half the goods sent thither in the fleets were the property of Hollanders, under the names of Spaniards, although Spain was at war with Holland. Partly this was attributable to the disordered currency, and the communities throughout the Peninsula supplicated the crown for relief. There was but one way to obtain this—by retracing the vicious course of the last half century, and the attempt was heroically made. By a *pragmatica* of August 7, 1628, it was decreed that after the day of publication all the vellón money should be reduced one half in value. To diminish the loss to the holders a complicated arrangement was ordered, by which one half of the depreciation should be made good to them by their towns and villages, and in view of the sacrifice thus imposed on the nation the royal faith was solemnly pledged by Philip IV, for himself and his successors, with all the force of a compact between the crown and the people, that the value of the vellón coinage should never again be tampered with, either to raise or to depress it. After this, any transaction disturbing the parity of the various coinages was declared an offense subject to the severest punishment and to render the measure effective the sternest penalties were directed against the introduction into the kingdom of foreign vellón money. The profits on this had already called forth the most vigorous efforts of repression, and these were now sharpened by declaring it to be a matter of *lèse majesté*, and subjecting it to the pains of heresy—death by fire, confiscation of all property, and disabilities inflicted on descendants to the second generation. Any vessel bringing it, even without the knowledge of the master, was forfeited; an unsuccessful attempt to import it was punished with death, and knowledge of such attempt without denouncing it incurred the galleys and confiscation. For a while, in fact, the crime was made justiciable by the Inquisition, which was a tribunal inspiring far greater popular dread than the ordinary courts. Evidently the law-making power in Spain had few scruples, and no constitutional limitations in its control over the currency.

Yet with all its power it might as well have attempted to control the tides or the winds, and the solemn pledges of the throne were not worth the paper on which they were printed. Richelieu was pressing Spain hard, and the condition of Spanish finance was becoming more and more desperate. Recourse was again had to a forced loan under the device of another inflation of the currency. A royal *cédula* of March 12, 1636, called in all the restamped vellón; from the day of publication of the edict no one was to pass it, or spend it, or pay it out, but was to convey it to the nearest mint, where he would receive its current value; and whoever, after eighty days, was found in possession of any of it incurred the severe penalties decreed against the holders of unlawful money. Having thus provided for obtaining possession of all the coinage, the mints were set to work restamping it with a valuation threefold that which it had borne: the *quarto,* thus far current for four maravedis, was raised to twelve, and the other coins in proportion, while death and confiscation were threatened for any violation of the coinage laws. The result of this arbitrary creation of value is seen in the edict of April 30th of the same year, permitting a premium on gold and silver of twenty-five per cent until the arrival of the galleons, after which it was to be reduced to twenty; and that this was below the ruling market rate is assumable from a sharpening of the penalties provided for those who should demand or accept a higher premium. Six months later an effort was made to bring the precious metals to par by suspending the permission to exchange them at a premium, but the distress caused by this suspension was so severe that a decree of March 20, 1637, renewed the recognition of twenty-five per cent premium, and added that in the larger cities *casas de diputación*, or exchanges, could be established, where transactions could be negotiated at twenty-eight per cent, with a brokerage of one quarter or one half. The extreme importance attached to regulating the premium is visible in the punitive clauses of the edict. Any deviation from the established rate was classed with treason, irrevocably punishable with confiscation, disability for office, and personal infamy. In prosecutions all reasonable means of defense were withdrawn from the accused; the names of witnesses were kept secret, and judicial forms were not to be observed. Even ambassadorial immunity was set aside; the foreign ministers resident in Madrid were liable to accusation, when the king would determine as to their imprisonment and punishment.

This was speedily followed by a reaction. Of course, there were two parties in Spain, as elsewhere—inflationists and contractionists—and the policy of the state fluctuated as one or the other obtained preponderance with the king, or rather with his all-powerful minister, the Count-Duke Olivares. The contractionists now had control, and their views were expressed in a *pragmatica* of January 29, 1638, which lamented the misfortunes brought upon the land by the superabundance of vellón money which had injured commerce, had raised extravagantly the prices of the necessaries of life, and had driven silver out of circulation, depriving it of its natural function as money and converting it into a commodity to be bought and sold, while the only currency was the debased coinage, fabricated for the most part by the enemies of Spain, eager to gain the enormous profits accruing from its manufacture. As this, if unchecked, may work the ruin of the kingdom, the king declares that he has had the matter repeatedly discussed by his ministers, and as the result he orders that all the unstamped vellón money shall be melted down into bullion and be sold for silver, the proceeds being used to purchase more of the precious metal. It is expected that the vacuum thus created will bring silver into circulation, and to aid in this all the bullion brought by the galleons shall be coined; moreover, the savage edict of 1628 against the introduction of vellón is repeated; even the importation of copper is prohibited, and the laws forbidding the export of the precious metals are ordered to be enforced with the utmost rigor.

Had this policy been steadily pursued, perhaps it would in time have restored health to the currency, but it was neutralized by the financial exigencies of the state, which kept the mints busy in turning out debased coinage. It was impossible under the circumstances for the contractionists to win more than a temporary ascendency, and with the progressive dilution of the currency the premium on the precious metals obstinately kept advancing, in spite of the laws which punished such traffic as a crime. A decree of January 21, 1640, declares that this has become more inexcusable in view of the large amount of silver brought by the galleons in 1639 and the activity of the mints in coining vellón. To render its chastisement more certain, the rate of twenty-eight per cent is permitted in open market, but only for four months, after which it will be lowered; special judges are provided whose sole business shall be to try infractions of this law; every case that is heard of shall be prosecuted, and negligent judges shall be severely punished. The laws forbidding the export of the precious metals shall be still more vigorously enforced, especially those which require merchants bringing foreign goods into the country to take away an equivalent amount in merchandise.

The revolt of Portugal and Catalonia brought fresh financial complications, and recourse was again had to the ruinous expedient of a further debasement of the currency. A *cédula* of February 11, 1641, orders all the four-maravedi vellón pieces to be surrendered to the mints, where they will be paid for at their current value; this is to be done within thirty days, after which they can not be paid out or otherwise used. They are then to be restamped and issued at the valuation of eight maravedis; all other restamped vellón is to be surrendered by May 15th, after which it is to be no longer current, and disobedience of these orders is visited with death and confiscation. The natural result of this measure is seen in a decree of September 5th of the same year, limiting the premium on specie to fifty per cent until the arrival of the silver fleets. That this was below the market rate is shown in the prohibition of all indirect ways of evasion and of dealing in futures. How this condition affected all transactions, large and small, and how business was conducted under the double standard, are illustrated in some statements now before me of the expenses of the Supreme Council of the Inquisition about this time. After summing up the aggregate of the salaries and other items, in one case twenty-eight per cent and in another fifty per cent is added to show the total amount to be provided in vellón. When governmental outlays were thus increased we can not wonder at the struggle to keep down the premium on the one hand while stimulating it on the other by constant dilutions of the currency. The situation affords a singularly forcible illustration of the power possessed by an inferior money to force a superior one out of circulation. The largest of the debased coinage was only a piece of a quarter of a ryal, equivalent in our modern American system to three cents, yet it had completely demonetized silver and gold, and had become the practical standard of value. The Spanish possessions were the chief source from which the civilized world obtained its supply of the precious metals, yet Spain, in spite of the most arbitrary measures, could retain none of them within her borders. So scarce had they become that for twenty years, from 1623 to 1642, there had been repeated decrees forbidding the use of gold and silver in the arts—their melting and fashioning by artisans, even their employment for plating and gilding and in embroidery. In 1642 these laws were supplemented by others prohibiting the sale of silver plate except to be broken up for coinage, and owners were tempted to bring it to the mints with the promise of a bonus of five per cent in vellón, in addition to the coin that it would yield. At the same time the laws against exportation were rendered still more rigorous, suspending even licenses to carry silver away for the royal service in Flanders and Italy.

The contractionist policy was now granted another trial, and a comprehensive scheme was evolved to get rid of the intolerable burden and bring all the various kinds of coinage to a parity. The partial attempt of 1628 had proved a failure; but if all the base money in the land could be controlled, there was reasonable prospect that another effort might be successful. To accomplish this a *pragmatica* was signed August 31, 1642, and sent under seal to the local authorities everywhere with instructions to open it on

September 15th. At the same hour throughout Spain they were to go to the shops of all bankers, brokers, agents, traders, etc., seize whatever vellón money they should find, weigh it, register it, and convey it to a secure place, where it was to be kept under three padlocks, the keys being held by as many officials. When this was done they were to proclaim that the value of all vellón money was reduced to one sixth: the piece that had been circulating for twelve maravedis was in future to be worth but two, and so forth. All discount or premium between the metals was prohibited for the future, under the customary severe penalties, and it was hoped that the general benefit thus derived to the community at large would compensate for the losses inflicted on individuals, but to lessen these there were vague promises held out of satisfaction to be adjusted by the registry of the amount of vellón seized; and it was suggested that the king would consider any propositions made by those who should prefer honors or privileges or some other advantages in lieu of satisfaction.

Apparently it was soon found that something more was needed to bring the refractory metals closer together, and a *cédula* of December 23d endeavored to accomplish this by diluting the silver coinage. The marc of silver, in place of furnishing sixty-seven ryals, was ordered to be worked into eighty-three and one *quartillo,* thus diminishing the value of the ryal by twenty-five per cent; and in accordance with this, the existing *pesos,* or pieces of eight, were declared to be worth ten ryals, the profit on those in private hands being generously left to the holders. Gold was more simply treated by marking up the crown from 440 to 550 maravedis, and by a subsequent decree of January 12, 1643, to 612. The effect of this on the specie premium was, however, neutralized by diminishing from 98 grains to 75·3, the amount of silver to the marc of copper in the *moneda de vellón rica,* and holders of the white metal were tempted to have it thus employed by offering to coin it for them in vellón without charge of seigniorage.

Taken as a whole, these decrees formed but a halting measure of contraction; but, even as it was, it brought a strain too sudden and severe to be endured, and the effort was soon abandoned. A *pragmatica* of March 12, 1643, announced that the vellón coinage (except some recent issue by the mint of Segovia) should in future be current at a fourfold increase of value, the piece of two maravedis being raised to eight and the rest in proportion. The dilution of the silver coinage was similarly revoked, or at least suspended until the arrival of the fleet; the pieces of eight were to be current for eight ryals and no more, while the gold crown was reduced to 510 maravedis. As usual, the royal word and faith were pledged that there should be no further variation in the value of the vellón coinage, and that it should remain forever on the basis then assigned to it. Of course, the premium on the precious metals reappeared, and efforts to repress it by law were vain. It had to be recognized, and in 1647 a decree permitted it to the extent of twenty-five per cent, with stern punishment for those who should exceed the limit.

There could be no prosperous trade subject to such fluctuations in the standard of value, and the royal revenues must have suffered accordingly, for the next change was distinctly a method of raising money. The old *calderilla* coinage of Philip II had remained thus far undisturbed, and now by a *cédula* of November 11, 1651, all the rest of the base coin was restored to the value which it had borne prior to the reduction of 1642. The profit of this increase was reserved to the crown by requiring all holders of vellón to bring it to the mints within thirty days, after which it was demonetized and could no longer be used as currency. They were to receive its present value in the restamped issue at the new rate, and any one hoarding or passing the old money after the expiration of the limit incurred death and confiscation. The premium on specie, in spite of the law of 1647, had already reached fifty per cent, and the sternest penalties were decreed to prevent its rising above that figure—for a first offense, confiscation and six years of *presidio* (service in the African forts) for nobles, confiscation and six years of galleys for plebeians; for a second offense, death without distinction of rank. If absolute power could regulate values, Spanish thoroughness would have accomplished it.

Kings may propose, but in matters like this it is the people that dispose. The natural result of this measure was to drive not only the precious metals but even the *calderilla* out of circulation. It required only six months to demonstrate the error committed, and a heroic effort to bring some sort of order into the medium of exchange was made in a *pragmatica* of June 25, 1652. Under this the old *calderilla* remained unchanged, but the *vellón grueso*, or large coinage, which had been advanced in value six months before, was reduced to one fourth, at which it was to be current until the end of the year, and on January 1, 1653, it was to be demonetized and its use prohibited under the severe penalties for passing false money. The plan of seizing it all and sequestrating it at a given hour throughout Spain was adopted, but the crown proposed to assume the loss, not only on about seven millions of the restamped coin in the treasury, but by giving to those who surrendered it assignations on the tobacco tax, bearing five per cent interest. All arrears of taxes were also receivable in it for two months, and various other methods were offered of relieving the community. All the *vellón grueso* thus received was to be melted down, and to make a market for the copper the laws prohibiting its importation, even in the shape of manufactured articles, were to be strictly enforced. It was argued that when this, which through its superabundance had caused so much trouble, was out of the way, there would remain only the *calderilla*, which would all be needed for petty traffic, so that for larger transactions the precious metals would come forth and circulate abundantly at par, compensating the nation for the losses and sacrifices entailed by the measure.

This was a bold attempt in the right direction, but it was too sudden and too severe to be successful. It must have caused abundant ruin and distress, and the clamor for relief must have become irresistible, for in less than five months another edict was issued (November 14th), announcing a complete reversal of the means proposed for attaining the end in view. This time the *vellón grueso* was retained as money and the *calderilla* was proscribed and demonetized on the spot. Those who should register what they held within fifteen days and surrender it within two months were promised the same satisfaction as that offered in the previous decree to the holders of vellón, and any one in whose hands it should be found after sixty days was liable to the penalties for circulating forbidden money. This reduction in the base currency, together with the large amount of the precious metals in the country and the yearly accessions by the fleet, it was argued, deprived any difference in value of all excuse. As this measure was the ultimate remedy whereby to obtain absolute parity between them, any deviation from such equality was declared a species of treason. Any premium or discount, however small, exposed all participating in it, whether as principals or brokers, to confiscation and deprivation of office and of citizenship. A special court was established for the prosecution of such cases, in which the trial was to be secret and the names of the witnesses withheld from the accused. Judges everywhere were ordered to see that prices were reduced by one third, and all outstanding debts and obligations were required to be settled at the same reduction.

This fresh disturbance of all business relations was as fruitless as its predecessors. The *calderilla* thus called in was not melted down but was restamped, and by a decree of October 22, 1654, was received at its old valuation. Large amounts had apparently been retained by the people in spite of the threatened penalties, and this they were told would be receivable for dues to the fisc at one half its nominal value, or might be taken to the mints and by exchanged for half the amount in the restamped coin. Forty days were allowed for this, after which its possession involved confiscation and six years of *presidio*, or galleys.

After this there was a pause in legislation until September 24, 1658, when an attempt was made to unify the minor coinage by withdrawing the *vellón grueso* and substituting a new copper issue of the same weight and nominal value as the *calderilla,* so that there should be but one kind of currency. To check the temptation to import imitations of this, the same savage penalties as before were re-enacted—confiscation and the stake, with the forfeiture of any vessel bringing it. The *vellón grueso,* however, refused to be withdrawn, and on May 6, 1659, a compromise was attempted by reducing it in value one half. Moderate as was this contraction of the currency, it served merely as a prelude for further inflation. Although the Peace of the Pyrenees, in 1659, might be expected to lighten the financial necessities of the state, a *pragmatica* of September 11, 1660, under pretext of providing a currency lighter, easier of transport, and more convenient for use, ordered all the *vellón grueso* to be called in and reworked, so that the marc of copper in place of producing 34 pieces of 2 maravedis should furnish 51 pieces of 4, thus trebling its nominal value. This must have called forth energetic expressions of dissatisfaction, for in less than two months—on October 29th—a new project was announced. The coinage of pure copper was stopped, and in its place a new alloy was ordered containing 20 grains of silver to the marc ($\frac{1}{230}$), to be worked into 51 pieces of 16 maravedis, and smaller coins in proportion. The existing *calderilla* and *vellón grueso* were allowed to remain in circulation, to be gradually worked over into the new coinage as they should reach the treasury. The new issue was styled *moneda de molino de vellón ligado* —mill money alloyed—shortened into *moneda de molino,** and added to the confusion by furnishing a third debased coinage, for of course the two older ones remained in circulation. The country speedily was flooded with the new currency, and prices began to rise still higher. Some relief was necessary, and, as usual, it was applied in a violent and summary manner. A *pragmatica* of 1664 reduced the value of the new *moneda de molino* by one half —the 16-maravedi piece was to pass for only 8; for thirty days it would be received at the old rate by the treasury in settlement of overdue debts and taxes up to the end of 1662; after thirty days it would be accepted only at fifty per cent of its face, and the Royal Council was vaguely ordered to adopt such measures as it should deem wise to prevent injustice between buyers and sellers, debtors and creditors. As there ought to be only one base-metal currency, moreover, the edict prohibited the further use of the

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* It seems to have been not long before this that the mill or machine for stamping was introduced, enabling coins to have a raised and milled edge, to check clipping. In the Indies the primitive *labor de martillo*, or hammering process, was maintained until 1728, when mills were ordered to be erected. Where practicable, these were run with water power; when this was not available, by mules.

calderilla and *vêllón grueso*—those coinages which had undergone so many vicissitudes, and which, in spite of prohibitions, persistently continued in circulation. They were a shirt of Nessus, clinging to the victim and impossible to discard.

Again the load became too onerous to be endured, and relief was imperative. The mints were pouring forth the *molino* money; there were quantities of it in circulation of pure copper illegitimately issued, and the land was filled with imitations brought from abroad. To remedy this, a decree of February 10, 1680, orders the simultaneous registration and sequestration of the whole, carefully distinguishing the three varieties. The first, or legitimate alloyed coin, was reduced to one fourth of its existing value—that is, the piece which had been originally issued for 16 maravedis, and had in 1664 been cut down to 8, was now still further diminished to 2; the same was done with the native counterfeits, while the foreign ones were accepted at one eighth of their current value. To soften the blow to the holders the legitimate *molino* was redeemable at the treasury in gold or silver at fifty per cent premium, and was receivable for sixty days for all overdue debts to the fisc up to the end of 1677, while, as a further act of grace, arrearages due up to the end of 1673, amounting to over 12,000,000 ducats, were forgiven.

This measure appears to have been designed as a preliminary to the total extinction of the *molino* money, for it was followed, May 23d, by an elaborate *pragmatica* demonetizing this wholly and forbidding its use, only twenty-four hours being allowed during which it could be spent for the purchase of bread, meat, and wine, and for nothing else. In all these efforts at contraction it was expected that the inflated prices, which were a standing grievance, would collapse with the diminution in the circulating medium, and when this result did not follow with sufficient rapidity, there was no hesitation in fixing a scale of *maxima*, for the transgression of which heavy penalties were threatened. Thus on the present occasion a most elaborate edict was issued, November 27, 1680, consisting of over a hundred folio pages, regulating all dealings. All rents in Madrid are to be reduced to what they had been in 1670, and for buildings of later construction or enlargement the rates are to be determined by the magistrates. Then follows a most extensive list of maximum prices, embracing nearly three thousand items, from raw materials by wholesale to finished products by retail, from wool by the *arroba* to rhubarb by the drachm, and including what a tailor should receive for making a coat and a washerwoman for washing a shirt. Such supervision by the state becomes endless, and a supplementary edict was requisite, May 2, 1681, supplying omissions and making changes. If currency and values were capable of governmental regulation, it would have been accomplished by Spain.

All this time the prohibited *calderilla* and *vellón grueso* were in circulation, the latter running 74 maravedis to the marc, or about 56 cents of our money to the pound, while copper was worth about 29. The legalized premium on gold and silver was still fifty per cent. Even copper was now becoming scarce under the ceaseless labor of the mints. A proclamation of May 14, 1683, sets forth that it is for the common benefit to have abundance of copper money; and, in order that all the metal in the kingdom may be thus utilized, all pieces of copper brought to the mints will be paid for at the rate of 3½ ryals of vellón for the pound. To prevent its being wasted by consumption in the arts, all coppersmiths are forbidden to manufacture articles of it, or to repair old ones that may be brought to them to be mended. Their shops are to be visited, and their stocks of metal seized and paid for at the above price; inventories of their finished work are to be drawn up, and sixty days allowed for the sale of the articles. Anything concealed is declared to be forfeited, and severe penalties of fine, confiscation, and exile are decreed for evasions or infractions of the order. A false financial system had brought Spain to such a pass that, with the wealth of the Indies pouring into her lap, gold and silver had been driven from circulation, and she was ransacking the shops for scraps of copper to keep her mints busy.

These resources proved insufficient to supply the ever-growing demands of a depreciated currency, and resort was had to remonetizing the *molino* alloyed coinage which had been prohibited in 1680. By an edict of October 9, 1684, it was restored to circulation at a valuation double that which it had borne prior to its demonetization, which would seem to render superfluous an accompanying threat of penalties for its exportation, the same as for gold and silver.

Having thus apparently exhausted the possibilities of copper inflation, attention was turned to gold and silver which had hitherto been but little tampered with. A *pragmatica* of October 14, 1686, ordered a reduction of weight of twenty-five per cent in the silver ryal by working 84 to the marc in place of 67. The existing pesos or pieces of eight were rechristened crowns, and were ordered to pass for ten ryals, and the smaller coins in proportion. This was purely an inflation measure without any view of reducing the discount on vellón, for the fifty per cent premium was ordered to be applicable to the new light-weight silver coins, of which the piece of eight was declared equivalent to twelve ryals vellón, and the old one, now called a crown, to fifteen. No change was made in the weight of the gold coinage, but the value was raised to correspond, the single doubloon, or gold crown, being declared worth nineteen silver ryals in place of fifteen, and a month later it was further raised to twenty. In this reduction of the standard the interests of the debtor class were tenderly guarded by decreeing that outstanding obligations in gold or silver could be settled on the new basis. Some concession, however, was made on this point where suits arose as to specie lying on deposit or bills of exchange drawn in silver or gold prior to the depreciation, for these were ordered to be paid at the old standard.

The War of Succession, which broke out in 1701, naturally brought large quantities of French silver into Spain. The *quart d'écu* was held for a time to be equivalent to the two-ryal piece, and came to be known as the *peseta* or little peso, but it was pronounced to be inferior in value, and in 1709 its further introduction was prohibited. At the same time the silver standard was reduced to eleven dineros or ·91667 fine in place of the ·925 at which it had stood for centuries. This did not arrest the progressive depreciation of the vellón currency, which in 1718 we find legally recognized in the equivalence of a silver ryal to nearly two ryals vellón, and not long afterward the regular exchange was as one to two. This was allowed by law, and it doubtless was frequently exceeded, for dealers kept the copper coin in bags representing fixed amounts, and those who preferred gold or silver were charged extra for it. This would have worked comparatively little evil if the inferior currency had been confined to the petty traffic for which it was originally designed, but for more than a century it had become the standard of value and the precious metals had been rendered merely a commodity. Thus in the regulations of the mints the salaries are all defined in *reales de vellón* or *escudos de vellón*, and the treasurer has to give security in twenty thousand *ducados de vellón* on unincumbered real estate. It was always necessary, when mentioning a sum, to specify whether it was in *reales de vellón* or *reales de plata*, and with the complexities which crept into the silver coinage we even sometimes find a further definition required, as in such expressions as "*un real de plata provincial, valor de 16 quartos de vellón.*" The evils entailed by the system were freely admitted, but the country had been plunged so long into this financial debauchery that recovery seemed impossible. In 1718 Philip V acknowledged the grave injuries which it inflicted on trade and commerce, but the remedy which he proposed was futile. In 1743 he again deplored the manner in which greed and malice had used the increase of copper money to drive silver from circulation and reduce it to the condition of merchandise. To remedy this he ordered that payments in vellón should not exceed 300 ryals, and he forbade any charge for exchanging the metals under the same penalties enjoined by the law of November 14, 1652—confiscation and loss of citizenship. It was in vain; the distinction between the coinages was too firmly established, and the tendency was even to increase the premium on the precious metals. In 1772 Charles III, in issuing a new gold coinage, prescribes that the gold crown shall be worth 37½ vellón ryals, and as it was equal only to 16 silver ryals, this shows a premium of over one hundred per cent.

The question of the premium on silver was further complicated by tampering with the silver coinage. In 1726 it was ordered that the *peso* or piece of eight should be counted for 9·5 ryals; the small silver coins of two ryals and less were worked 77 ryals to the marc, in place of the old weight of 67, and only 10 dineros fine in place of 11, thus lowering them to twenty per cent below the standard; and in 1728 the fineness was further reduced to 9 dineros (22 grains), or 0·798, increasing the deficiency to twenty-five per cent. The mintage of the Indies, principally in the larger pieces, was not reduced, and thus there came to be two kinds of silver coinage, known as the *nacional* or heavier, and the *provincial* or lighter. Between these there was a recognized difference of twenty per cent, the *real de plata nacional* being worth 2·5 vellón ryals, or 20 *quartos*, while the *real de plata provincial* was only worth 2 vellón ryals, or 16 *quartos*. There were thus three established currencies of different values, two of silver and one of copper, and for awhile there was a fourth, for we hear, in 1728, of a new coinage popularly known as *Marias*, which is ordered to be demonetized by July 1st next ensuing. The order, as usual, was disregarded, for in 1736 it was repeated, with a prohibition to draw bills of exchange in the forbidden currency.

The depreciation of the ryal has survived, to modern times, the revolution in the currency, which has become decimal, and is modeled on that of France. The *peseta* is the equivalent of the franc, worth approximately twenty cents in our money, and when ryals are quoted they are a fourth of the *peseta*, or five cents, thus being only two fifths of their nominal value in silver. Whether the vellón ryal has ceased to be the standard money of account I can not say, but I happen to have before me a draft drawn through the Bank of Spain, December 17, 1858, in Madrid on Jaen for "*la suma de tres mil reales de vellón en plata ú oro*," showing that accounts were still kept in vellón and that every transaction involved a conversion of this into specie.

There can be no exaggeration in attributing to these perpetual fluctuations in the standard of value a leading part in the industrial and commercial decadence of Spain. During the period we have traversed, Spain was the chief source through which Europe derived the precious metals, yet it could never retain them, in spite of savage laws prohibiting their export; its people were forced to content themselves with a debased coinage, and at times it could scarce procure enough copper to supply even this. Commercial and industrial enterprise was impossible when no one could know from day to day what was to be the value of the money which was due to him, or in which he was to meet his obligations, and consequently the magnificent resources of the land remained undeveloped, while the rest of western Europe was entering on the modern era of industrialism. Once embarked on such a vicious course, return to a permanent standard was too painful a process to be endured, and the efforts made toward it from time to time only aggravated the trouble by increasing the uncertainty, for the distress which they caused was too acute for even Spanish endurance. Thus it dragged on from century to century, while the wealth of the Indies enriched the nations whose commercial instincts taught them the essential necessity of an unvarying standard of value. This was no new discovery, for the long-enduring prosperity of Florentine manufactures and commerce was largely attributable to the jealous care with which the republic preserved the purity and weight of its coinage, so that the florin became a recognized standard throughout Europe, the honesty of which no one ever questioned. Florence had learned the lesson from the Byzantine Empire, whose historian, Mr. Finlay, asserts that its prolonged duration was greatly owing to the wisdom which preserved its coinage unaltered for eight centuries, so that "the concave gold byzants of Isaac II (1185–1203) are precisely the same weight and value as the solidus of Constantine the Great." With the Latin conquest in 1204, barbaric recklessness was introduced from the West, and successive debasements of the coinage accompanied the decay and extinction of the empire of the Cæsars. Spain affords an exceedingly instructive example of the opposite, inasmuch as its trouble arose from a token currency of small denominations which was incautiously allowed to expand until it dominated the whole financial system, to the exclusion of the precious metals.

THE "Australian Snow Country," as Mr. John Plummer, of Sydney, calls it, includes a region in the neighborhood of Mount Kosciusko and the Munoing Range where fires and blankets are needed, even during the hottest days of that continent of summer torridity. Mount Kosciusko, 7,171 feet high, is the highest peak in Australia, but is remarkably easy of ascent. The climb begins twenty-five miles from the top, and is practicable for a drive all the way. There are no trees within several miles of the top, but gigantic mosses grow there and beautiful flowers.

THE HAWKS OF NEW ENGLAND.

By WILLIAM E. CRAM.

DURING the middle ages, while "the noble sport" of falconry was in vogue, hawks, and to a certain extent all kindred birds of prey, were respected, revered—almost worshiped—contemporary naturalists, and even their successors for many centuries, placing them at the head of their order, much as man is ranked as the head of all mammals. Recently, however, as scientific methods have taken the place of romantic fancies, a change has shown itself, and the whole tribe has been moved down almost to the foot of the list, where in the minds of bird students they occupy a position only a little more dignified than that of the penguins and similar seafowl. Nowadays it is the fashion to speak of them as robbers and butchers, low in their grade of development, and lacking even in intelligence.

Without denying the justice of all this, I must still confess to a strong admiration for them, having always found them more interesting than any other group of birds.

Of course, the literature touching this particular subject is very great, and it is almost a hopeless task to try to write anything new; still, since the favor into which the smaller birds have fallen of late has resulted in a rather undeserved oblivion for the once-honored falcon, it may not be out of place to note anew their varieties and characteristics, since their commonness in this country makes study very easy, while their almost forgotten qualities well repay one for a little attention. In speaking of them I shall not class them in the order assigned by the old naturalists—viz., as long-winged or noble falcons, short-winged hawks, and ignoble kites and buzzards—but according to their size, as they are generally known by farmers and hunters, the bitter enemies that now concede them attention, and take the place of the courtly nobles who treasured them as almost their most precious possessions.

Of the largest hawks, there are quite common with us the rough-legged, the red-shouldered, and the redtail: the first is known as the winter hawk, the others are the hated hen hawks, and are hardly to be distinguished one from another. From April to November they may be seen sailing in wide circles over the woods and pastures, or perched on some dead tree from which they may overlook their hunting grounds.

Redtail is probably the heaviest of all our hawks, and he shows his weight as he flies, while a pretty large branch may be seen to bend if he lights on it. He has a fierce, long-drawn, savage scream, and his tones are usually angry and harsh. Hen hawks are most abundant during the last part of summer, and at that time if a flock of poultry should stray out into the field a single hawk will sometimes kill two or three of them before they have reached a place of safety.

Although only a buzzard, he kills his prey with a single stroke, like a true falcon, and his capacity is enormous, yet sometimes for weeks together he is content to live entirely on mice and grasshoppers. His color is grayish brown above, and yellowish white beneath, with traces of rusty red on the tail feathers, which, when the bird is in full plumage, become wholly red with a black band near the tip.

But trying to know hawks by their colors is uncertain work at best, as members of most species change their entire coloring at least once in their lifetime. These changes are popularly ascribed to age, birds in full plumage being spoken of as old ones, though they have always seemed to me to depend more on the general vigor of the bird, as it is not uncommon to find specimens showing every mark of great age, with stiff joints and beaks and claws worn blunt, in precisely the same attire as when they left the nest, while those in full plumage, as far as my observation goes, are never very old, and are always in excellent condition.

Red-tailed Hawk.

The red-shouldered hawk is smaller and more lightly built than his cousin, and he has a longer tail. In full plumage he is rich brown on the back, with wings and tail barred with black and white, and chestnut-colored shoulder patches. Beneath he is dull red, more or less barred and spotted with white. Young birds are much the same color as redtailed hawks. This bird keeps more to the woods than the redtail, and is much less destructive; his cries are shorter, shriller, and less savage, and his general disposition is milder. In the spring they are especially noisy, and then several pairs may sometimes be seen circling together high in air, all whistling and screaming at the same time.

Red-shouldered Hawk.

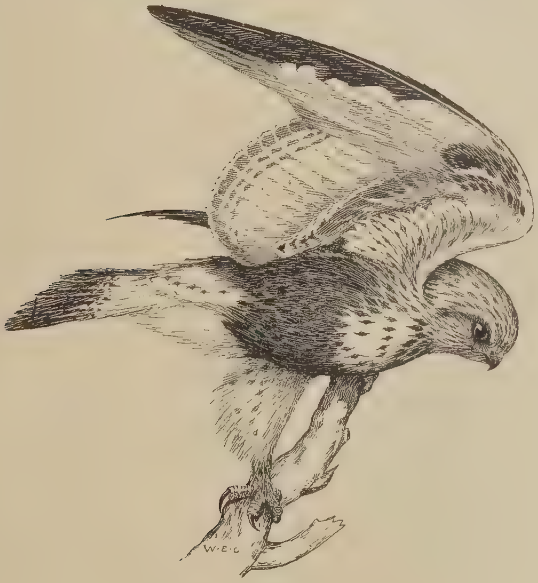
Occasionally a pair will remain all winter, and during this season they will keep to the thickest parts of the woods and loaf about open springs, feeding on such half-dormant frogs as rise to the surface of the water. They never appear to suffer from want of food, however, as all those I have killed in winter had a thick layer of fat under the skin.

Although the rough-legged hawk is usually spoken of as rare in this part of the country, they seem to be common enough here in southeastern New Hampshire, at certain seasons at least; and during the Indian-summer weather that comes just before winter sets in, I can at almost any time find one or more without the least trouble. Perhaps it is because they are here at a season when other birds—and hawks in particular—are most conspicuous by their absence that this species is so well known; still, there seems to be something different in their method of flight and ways in general. One peculiarity the rough-legged hawk shares with the little sparrow hawk—that of hanging like a wind-hover in midair, head to the wind, with dangling legs, his keen eyes watching the grass beneath for any sign of a mouse. With a continual rolling flap of the wings he holds himself, hour after hour, over precisely the same spot. At the first glimpse of a mouse he goes down with a perpendicular rush like a falcon, and flounders and flaps around until he has the little victim in his claws.

Judging from my own experience I should consider this the most intelligent of hawks. With the utmost caution I find it almost impossible to approach within two hundred yards when I have a gun, even in the best of cover, and yet they will sit on the trees by the roadside and let carriages pass almost under them, or fly back and forth within fifty yards of a team. Apparently they have less fear of skaters than of pedestrians, probably having learned from experience that any one on skates is hardly likely to prove dangerous. They seem to see every one and everything within a radius of a quarter of a mile, and never lose sight of one for a moment. Most of those that I see are dark brown, with a dark belt underneath, and the base of the tail is usually white. Others are dark brown above and nearly black beneath, the tail white with bands of black and gray near the tip. The colors vary, however, from dark to light, a few being quite black, with white spots on the tail and under the wings.

They are seldom seen here in midwinter, but when the ice breaks up in the spring they pass over on their way north, and sometimes stop for a few days in the meadows.

Another large hawk, whose swiftness and courage made him a great favorite with the old falconers, is the goshawk, but as most of them are colored like some of the other large hawks, and are, moreover, extremely shy, keeping always to the dark, evergreen woods, it is sometimes hard to be certain about having seen one. This species could hardly be called common, though occasionally in August birds that I take to be goshawks are very



ROUGH LEGGED HAWK.

abundant. I am not absolutely certain, however, as to the species.

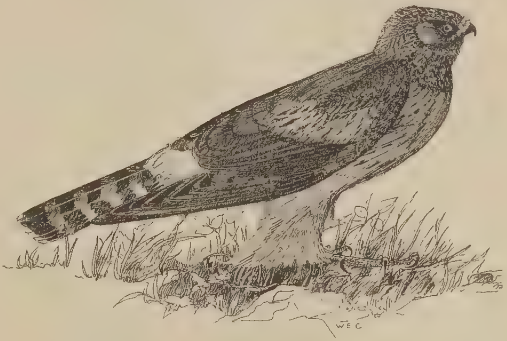
One August afternoon I heard an angry croaking that seemed to issue from the top of a large oak. As I approached a goshawk waddled out along a horizontal branch, and on another that extended parallel with the first and only a few inches below marched a crow, keeping directly under the hawk and striking savagely at his feet. Both kept their wings tightly closed, and neither seemed in the least excited. I do not know how the quarrel ended, for presently both flew to another part of the woods to argue the matter away from human intelligence. There seems to be a continual feud between the crows and all kinds of hawks, and some of the disputes that arise are humorous in the extreme. I once saw a sharp-shinned hawk that insisted on flying south in company with a flock of crows. To be sure, if he flew at the same height as they did, he would have to fly with them, for the sky was full of crows at the time, all going in the same direction; still, he might have risen above them or kept down nearer to the tops of the trees, but evidently he didn't choose to. Every time a crow dashed at him he would sweep down out of their ranks, only to join them a few yards farther on, and when, miles away, they were only just visible through my glass, the dispute seemed still in progress.

GOSHAWK.

In full plumage the goshawk is bluish-slate color, and differs from the other large hawks in having shorter wings, longer tail, and yellow or orange-colored eyes.

When flying, the marsh hawk has the appearance of being a large bird, but in weight he would be classed among the smaller hawks. A lean-bodied, loose-jointed, long-limbed bird, he sails along close to the grass, carefully beating over ever foot of ground in his day's hunt. The small birds seem to realize that it is useless to try to escape as they do from other hawks by hiding in the tall grass, and as soon as one appears you may see meadowlarks, blackbirds, reedbirds, and sparrows rise in clouds and fly for the nearest woods for protection. When there is a flight of warblers, and the treetops are alive with these brilliantly colored little fellows, the marsh hawks follow them and rise and dip among the branches like swallows in a listless, careless manner, striking with their long legs at whatever bird happens to be nearest. They are very methodical in their way of hunting, and day after day follow the same course, flapping back to the nest whenever successful. They nest on the ground in a swamp or brier patch, and the young remain hidden about in the bushes, where they are fed by the parents for months after they are able to fly. All their cries are rather faint and hysterical, and they always seem to be somewhat weak-minded; still, they show considerable intelligence at times, and appear to distinguish between persons. I remember one pair that became quite friendly, and, when I visited their nest, would light near me or hover close over my head, even when I carried a gun; but a neighbor of mine, who accused them of stealing his chickens, complained that they would not come within gunshot, even when he thought himself well hidden. In color they vary from pale, bluish gray to dark brown above, and from white to chestnut red underneath, and are easily known by the large white patch on the back. They are abundant from the last of March to November.

For medium-sized hawks we have the peregrine falcon, Cooper's hawk, and the broad-winged hawk. The peregrine falcon is a rather uncommon bird. I occasionally see them in the spring, but not often. This is the falcon *par excellence* of the older writers, and is said to be the most dashingly courageous of all hawks.



MARSH HAWK.

The broad-winged hawk is also rare, but less so than the last; he looks like a heavy, owlish fellow, with broad, rounded wings, and a short tail that seems to be inserted between them. He is usually seen in frosty October weather, and spends most of his time in the woods. Cooper's hawk, or the chicken hawk, is plentiful enough: a slender, compactly built bird, with a long tail, short wings, and fierce, yellow eyes, steely blue or rich brown on the back, and white-barred or streaked with reddish on the breast. He flies with tremendous swiftness, and doesn't seem afraid to tackle anything.

This is probably the most destructive hawk we have, a nest with young birds usually containing remnants of partridges, chickens, and perhaps a dozen kinds of small birds, but very seldom any signs of mice or insects. When together, these chicken hawks are always quarreling with each other, and pairs separate about as soon as the young birds are able to take care of themselves. Their scream is, I think, the most petulant, angry, ear-piercing note to be heard in the woods.

The three small hawks are the merlin, the sharp-shinned, and the sparrow hawk. The first two are commonly called pigeon hawks. Sharp-shinned is almost exactly like a small Cooper's hawk, but not so compactly built; in disposition he is quite as bad, and makes up in general recklessness what he lacks in size; he is less businesslike, however, and flies through the woods in a crazy, erratic sort of way, apparently with no particular object in view, striking savagely at every living thing he sees, though seldom following a bird if he misses it the first time. These birds have a curious way when alone of darting back and forth between two branches, striking with their claws at some particular knot or leaf, as if for practice, and then performing a most indescribable kind of war dance. Being especially fond of young chickens, they will come day after day to the same yard, and are only too often successful in their hunting. At such times it is almost impossible to shoot them, as they come with a rush and are gone,

Broad-winged Hawk.

sneaking from orchard to orchard, and you have to guess at their whereabouts from the cries of the small birds that have nests in the neighborhood. A colony of swallows, however, makes an excellent pack of sky hounds to hunt them with, as they keep directly over the hawk, and by watching their movements you may judge what direction to take in order to head him off. Even if you get a good shot at him you may call yourself lucky if you succeed in bringing him down, for he is harder to hit than snipe or woodcock, and is rarely captured until fairly riddled with shot.

Merlins are solid, muscular, beautiful little birds, with close-fitting, dark-colored plumage. They are never very numerous, except in the fall, when they come in flights, and are most abundant near the seacoast and salt marshes. They fly swiftly and steadily, seldom changing their course, and as sure as one of them starts in pursuit of a bird that bird is doomed, for the merlin seldom gives up the chase.

He is not a difficult bird to shoot, for, though tenacious of life, his flight is steady, and, as a general thing, on being hit by a shot, he turns and flies back in the direction whence he came, giving the sportsman a second chance.

In my opinion, the sparrow hawk is the handsomest of his race; his back is bright, golden cinnamon, his wings steely blue and jet black, and his tail chestnut, with a broad black band; his breast is beautifully marked with chainlike patterns of black spots. His mate is chestnut above, banded with black. Unlike other hawks, the plumage of these birds does not vary with age. They usually make their appearance in some still, cloudy day, about the last of March, and take up their position in the meadows; from then until September they are always to be seen either perched on the topmost twig of some tall elm or hovering in the air on the lookout for prey. Their nest is in some hollow tree or deserted woodpecker's hole, or even a last year's crow's nest. I have often tried to account for the seemingly friendly relations existing between the sparrow hawks and golden-winged woodpeckers; both frequently occupy holes in the same branch, and sit side by side on top of some tall stub without the least sign of disagreement, although, unless I am very much mistaken, the sparrow hawk often attacks larger birds, and might easily carry off the young ones when the old birds were absent.

About the last of June the young hawks are ready to fly, and at once betake themselves to the nearest thick treetop, preferring an evergreen if possible. They appear to enjoy the change from their former stuffy apartments immensely, and preen their feathers in the bright sunlight, each waiting patiently its turn to be fed by the parents, who are chasing the half-fledged blackbirds and sparrows about the meadows, or darting after grasshoppers and locusts in the grass. At the first cry of warning the youngsters scramble down into the thick foliage, and hide there as skillfully as young owls. At first they have no especial fear of man, and sometimes on approaching them I have seen the old birds deliberately knock them off their perch and compel them to fly, driving them into the pines for safety.

Cooper's Hawk.

I once took a hawk of this kind from the nest when only a few days old, and brought him up according to the rules most approved by the old falconers. He was never confined in any way, and as soon as he had learned to fly had the run of the entire place. His favorite haunt was a series of gutters under the eaves, where he would spend hours at a time hunting for spiders or digging the wasps' nests to pieces for the larvæ. When spoken to at such times he would look out over the edge of the gutter, with his head on one side, and answer with soft, chattering cries, and immediately go back to his work. Let no one make the mistake of thinking that the loud screaming or whistling of hawks is their usual voice, although it is the only one easily heard at the distance hawks usually insist on keeping from the observer. One has only to watch a pair of hawks of any kind close at hand, to learn that probably nine tenths of the cries uttered by them in the course of a day are either low and guttural or soft and almost musical. But it was not until I had had one about me for an entire summer that I realized what an almost limitless variety of notes he had at his command. Sweepstakes, as we named him, would sit on my shoulder or the rim of my hat, and chatter away with so much expression that it seemed the worst kind of stupidity on my part not to be able to understand everything he said. When he had gained the full strength of his wings he would come flying to me for protection from a furious mob of small birds which he had exasperated by his bungling attempts at hunting, and alighting on the rim of my hat go scrambling round and round it with a great rustling and scratching of his claws. When perched on any one's wrist or finger, he was always careful not to let his claws prick the skin, and was more thoughtful about such matters than the best-natured kitten in the world. He was especially fond of being stroked with the wing feather of some large bird, and was always uneasy if any of his own feathers were ruffled or misplaced. He would almost always come when called, even though not in the least hungry. Sometimes if he saw Jack, the white bull terrier, going about with a bone in his mouth, he would light on the bone and ride there until he had eaten what he wanted. If it took him some time to get enough, Jack, who was a most exemplary gentleman, would drop the bone, and lying down beside it quietly wait for his very good friend to finish. But his very fearlessness proved his destruction, for he got into the way of flying across the pastures to a farmhouse half a mile away, and was shot, to the bitter regret of all who had known him.

SPARROW HAWK.

The next season I took a female sparrow hawk from the nest, when nearly grown, but she was never quite as familiar as Sweepstakes, and in a few days ran or rather flew away. If she had gone north toward the meadows, she would probably have found her parents, at that time engaged in teaching her brothers and sisters the rudiments of hunting, and would probably never have returned. Instead of this she took the opposite direction, and in a few days came back with a tremendous appetite, hungrily eating everything that was given her. When haying time came on she would follow about the field, lighting on rake handles or shoulders, or even the cart, when she was not feeding on grasshoppers till she could hardly fly. Toward the end of summer she would be gone for days on hunting excursions, her ability in this direction having increased, but on her return would be as familiar as ever.

One day, however, she appeared nervous and frightened, and on taking her in my hand I noticed that shot had cut through her wing feathers, and those on her breast were rumpled and bloody. Suddenly she caught sight of some one in the road more than a hundred yards away, and was instantly in the air, soaring out over the fields and up toward the clouds until almost out of sight. She seldom came about the house after that, and though when I saw her in the meadows was apparently not afraid, she yet refused to come at my call. Early the next spring a female sparrow hawk lighted on the roof of the barn, and at one time seemed to show signs of coming down to me, but evidently thought better of it, and flew off toward the north. Perhaps it was only a wild hawk; still, I prefer to think that she is still alive, and has escaped those who shoot hawks only to obtain the bounty offered for their scalps by the State.

WHILE traveling in the Balearic Islands, M. Gaston Vuiller, passing through a gorge in Minorca, found the road barred by extemporized stone walls, tree trunks, and all sorts of loose obstacles, while the foliage above was hung "with colored ribbons and garlands of flowers and fruit, like the route of a triumphal procession." This was in preparation for a wedding festival, and in obedience to a custom of placing every possible obstacle in the way of brides and bridegrooms in order to remind them how difficult is the path to happiness, while the festoons above express the good wishes of the people. The proper attention for a lover on this island to pay his sweetheart is "to steal silently upon her from behind and suddenly to discharge his musket into the ground at her feet, and a well-brought-up girl never winces under the trial." Suitors announce their good feeling for the family by discharging a musket in the sitting room after spending the evening with them, but before saying "good night." If the "good night" has been said, the firing is held to signify a challenge to a rival.

PRINCIPLES OF TAXATION.

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X.—NOMENCLATURE AND FORMS OF TAXATION.

(*Continued from page 480.*)

"REAL" AND PERSONAL TAXES.—Direct taxes are also spoken of, and in fact, classified as *real* and *personal* taxes. "*Real*" taxes (Latin *res,* thing), or taxes on realty, as is the general expression, are taxes on property—generally on things naturally characterized by immobility—without reference to the pecuniary condition of the owner, and hence without taking his debts into account. A tax on land or real estate—houses and land—is a typical tax on realty; and a tax legally assessed upon such property rests, or is a lien upon it, irrespective of its ownership.

Business taxes are regarded as real taxes, as they are taxes on pursuits or occupations rather than on persons. The same is true of taxes on capital and the rental value of land or buildings.* The restriction on the levy of direct taxation imposed by the Constitution of the United States on the Federal Government does not apply to the States.

Personal taxes are taxes on persons. A poll or "capitation" or "head" tax, implying a uniform payment from every poll or head of some portion or all the population of the State, would be a typical personal tax. Strictly speaking, therefore, a personal tax can be no other than a poll tax levied under the above conditions. What are usually called personal taxes are taxes assessed or rated to a person, not as in the case of a poll tax because he is a person or citizen, but in virtue of the movable property—furniture, clothing, vessels, carriages, animals, money at interest, stocks in corporations, bonds, or negotiable instruments and the like belonging to him. It is the individual that the law regards as the objective rather than his personal property—which may not be tangible or visible—on enforcing the tax; the property being resorted to for the purpose of ascertaining the amount of tax which its owner should pay. An income tax is regarded as a personal tax because it is assessed on the income that gathers about a person irrespective of its source—rents, interest, profits, salaries, and the like. A tax on land is a tax on realty, while a tax on a mortgage is a personal tax, which is equivalent to affirming that the former is a *thing*, while the latter is only the representation or shadow of the thing.

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* "Real estate for the purpose of taxation shall include all lands within this State, and all buildings or other things erected on or affixed to the same."—*Statutes of Massachusetts.*

In levying taxes on realty the owner, as a rule, is not allowed to offset or reduce its valuation by the amount of his outstanding indebtedness; but in the case of the taxation of personal property such an offset is generally permitted, on the ground that a man should be taxed only upon what he *owns* and not upon what he *owes*; and even when not allowed by law, the circumstance of indebtedness is almost always taken advantage of by persons assessed, for reducing valuation in making returns to the tax officials of the value of their property. In assessing an income tax a deduction is allowed for interest paid on mortgages, and such business expenses as lessen income. Personal expenses, as house rent, cost of living, and the like, can not, on the other hand, be properly deducted from income before it is taxed, because income is sought for and exists for the purpose of defraying such expenditures. By the income-tax law of the United States, enacted in 1865, and also in 1894, deductions were allowed from the amount of taxable income, of all taxes paid within the year, of all interest paid on indebtedness, and the rent or rental value of any homestead actually occupied by the taxpayer.

One of the most curious features of recent tax experiences in the United States has been the extent to which this practice, or right of reducing valuations of personal property for taxation by debts, has been made the opportunity for evading taxation. Thus, by the very structure of the Federal Government, its various instrumentalities, as heretofore explained,* are necessarily exempted from all taxation by the States of the Federal Union. Recognizing this, it has been the habit of individuals to effect *credit* purchases to a greater or less amount of United States securities a short time previous to the time fixed for tax returns or valuation, and then offsetting *the debts* thus incurred against valuation, evade the taxation on their personal property to which they would otherwise be subjected.† And for such moral wrong there would appear to be no legal remedy on the part of the State, except by the commission of a greater wrong—namely, the prohibition of the offsetting of all debts in tax valuations; or, what is the same thing, the imposing of a discriminating burden of taxation upon persons who, for any cause, may be in debt—a denial of equity which public sentiment in every free country will not long tolerate. A further proof and illustration of this averment may be found in the fact that years ago the Constitution of Ohio provided that credits, or evidences of indebtedness, should be subject to taxation by a uniform rule; and the Supreme Court of Ohio subsequently decided that this did not allow any offset of debts owed against credits owned. But popular opinion was so adverse that by common consent this clause of the Constitution, as interpreted by the court, was entirely disregarded in making up tax valuations.

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* See Popular Science Monthly, vol. l, No. 3, p. 289; vol. l, No. 4, p. 468.

† When the Federal Government effected in November, 1894, a loan for $50,000,000, a premium was paid on no inconsiderable amount for the privilege of purchase, or investment, so large as to net to the purchaser an abnormally low rate of interest—2·5 per centum. The explanation of this action was that, apart from the recognized value of an unquestionable security, the investment carried with it an exemption from a national income tax of two per cent, as well as from State and municipal taxation—so that the rate of interest accruing to the purchaser was not as low as it might have seemed to be, and by the holders and managers of trust properties was generally regarded as satisfactory.

In old English history the division of property into *real* and *personal* was wholly unknown; and all laws regulating this species of property, with a view to taxation or inheritance, are of comparatively modern origin.* It is also interesting to note that probably full one fourth of all the so-called personal property of this country—namely, all railroad, steamship, telegraph, telephone securities—did not have an existence fifty years ago.

As is the case with direct and indirect taxes, the line of demarcation between real and personal property, and consequently between real and personal taxes, is very indefinite, and some very nice and curious points in connection therewith have been established by usages, or court decisions. Thus an apple on the tree is real estate, but when fallen upon the ground it becomes personal property. Running water accumulated in a pond is real estate, though the owner is not permitted to invest it with the peculiar attribute of real estate—namely, stability—by permanently arresting its flow. In some States the engines, water wheels, shafting, and even belts of factories are real estate, while looms and lathes are personal property. Stone in the quarry is real estate, but when thrown out by a blast and made ready for market it becomes personal property. Hop-poles, not standing, have been decided to be real estate, but wood cut and corded for sale is personal property. A statue exhibited for sale in a workshop is personal property, but when placed upon a permanent foundation (although not fastened to it), as an ornament in front of a house, has been held to be a part of the realty. Chairs in a theater and screwed to the floor, as they can not stand alone, are considered a part of the realty; but gas fixtures and mirrors, made to order for the house, and attached to the freehold, but removable without injury thereto, are not deemed a part of the realty. Before emancipation in the United States, slaves, which by the Federal Constitution were recognized as persons, were in several of the States declared by law to be real estate;* and in one State of the Union, Wisconsin, the one species of property which is especially typical of mobility, and is of no value apart from its capability of motion, namely, the rolling stock of railroads, has been by law made real estate. Shares in the national debt of France, as well as stock on the bank of France—instrumentalities which in the United States would be regarded as personal property in its most typical form—may by French law be made real estate, and as such be administered on.

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* The first authorization of local taxation in England was for the maintenance of the poor, and occurred in the reign of Elizabeth. At that time it seems to have been assumed that there was no personal property in the kingdom capable of being assessed, and that real property was alone valuable property. Hence it was enacted (43 Elizabeth, cap. 2) that overseers should be appointed who were to raise, by taxation of every inhabitant, parson, "and of every occupier of lands, houses, tithes impropriate, propriations of tithes, coal mines, or salable underwoods in the said parish," moneys for the relief of the poor. No mention was made of personal property, and it is probable that every kind of property then known was mentioned in the act. When fresh burdens were necessary the principle adopted by the act of Elizabeth was continued, without much inquiry or opposition, and owners of personalty have remained exempt from taxation, although personal property has gone on increasing until its value has become much greater than all the real property of the kingdom.

Some years ago the following curious experience occurred in one of the New England States: A person rented a farm, and on the expiration of his lease attempted to remove from the estate the manure which had accumulated during his holding, assuming that he had the right to it as personal property. The owner of the farm, on the other hand, forbade the removal of the manure, on the ground that it was real estate, and so a part of the farm. The case found its way into the courts, and on its trial the lessee and defendant who appeared for himself, attempted to substantiate the legality of his proceedings in the following manner: Addressing the judge after the facts in the case had been established, he asked, "Was the hay in the barn personal property?" *Judge*: "Certainly." *Lessee*: "Were the horses and cattle personal property?" *Judge*: "Without dispute." *Lessee*: "Then will your Honor please to tell me how personal property can eat personal property and produce (dung) real estate?" The decision was nevertheless in favor of the owner of the farm, or the plaintiff. Subsequently the courts of New York decided that manure accumulated in connection with a livery stable, not being an agricultural product pertaining to a farm, was not real estate but personal property.

In a case in the State of Tennessee, where a person who had entered a neighbor's field and removed corn on the stalk was prosecuted for larceny, the court held that the offense was not larceny, which is the unlawful taking and carrying away of personal property, but trespass, inasmuch as the corn not severed from the ground was real estate, but would have been larceny if the corn had been gathered or disconnected from the ground previous to its taking. Thereupon a bill was introduced into the Legislature of Tennessee to make it a felony to steal corn from a field under any circumstances.

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* In American colonial days slaves were regarded as belonging to the land, and figured in tax valuations as real property.

From these illustrations it seems obvious that the distinction between real and personal property and real and personal taxes is, to a very great extent, an artificial and not a natural distinction.

The following are some of the other terms used to designate particular forms of taxation, the meaning and technical application of which may not be readily apparent:

A *franchise tax* is a tax on a franchise, or on a right granted by a State to a corporation or association to exercise certain privileges. In fact, a franchise *is a privilege*, and in most cases it is an exclusive privilege, and has an actual value largely disproportionate to the amount of capital invested by the company or corporation upon which it has been conferred.* It has been held by the courts that a franchise tax is not a tax on capital or on real estate, but on privilege, and does not exclude additional taxation on any property covered by the franchise.

The terms *imposts* and "*customs*" (Latin "*consuitudines*") are generally understood to mean indirect taxes on the importation of commodities, while the term *duty* is more properly applied to a tax upon exports.

The origin of all these terms is obscure and involves some interesting features in English history. It appears certain that they were in the first instance applied to exactions on trade generally, and not, as was finally the case, on imports and exports exclusively, and were in use before indirect taxes on personal property were recognized in England. At the outset and for a long period they were also not regarded in the light of taxes, but rather as dues personal to the sovereign, which he had the right to regulate and collect independent of any statute, and which carried with it the further right to restrain at pleasure the import or export of any commodity.* Thus, until the reign of Edward II (1272–1307) the right to tax the export of wool was exclusively a royal privilege; and the enactment of a statute by Parliament in 1275, limiting the amount that the king could take in respect to the export of wool, skins, and leather—but not denying the privilege—is regarded as the first legal foundation in England of the customs revenue. The controversy between the king and Parliament over customs duties went on, however, with varying phases until finally settled in 1682; and from these circumstances, and also from the fact that customs and duties are unseen by those who finally bear their burden because they are embodied in the prices of commodities, has possibly come about the curious idea that tariffs, or taxes on imports, are not taxes on any one or are any burden on property, but rather some sort of a business contrivance for the raising of revenue, and, if they are taxes at all, then that the foreigner pays them.

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* The following is a case in point, derived from actual experience: A street railway company in a city of the United States reported the gross earnings of the corporation for 1891 at $1,188,000. Its net earnings were $400,000, or nearly six per cent on a capitalization of $7,000,000. Its city property tax was only $11,000, or $2.10 on $500,000. It is evident, therefore, that the value of the capital of this corporation was due largely to the value of its franchise.

The value of a franchise is an eminently proper subject for taxation, though it is not commonly so regarded. The Supreme Court of Pennsylvania, in a recent case (1894), has held that under the laws of that State it was proper and lawful in ascertaining the actual value of the capital stock of a corporation (Susquehanna and Schuylkill Railroad Company) to take into consideration, as affecting that value, the franchises of the company. Franchises conferred by Congress upon a corporation created by it, to be exercised within a State, can not be subject to taxation by the State without the consent of Congress.—*California vs. Central Pacific Railroad Company.*

The term *impost* is a general expression for any tax, duty, or tribute, but is seldom now applied to any but indirect taxes on imports.

The term *excise*, though used in the Constitution of the United States, is now almost entirely restricted in use to the tax system of Great Britain; and even there has acquired a far different meaning and application from what it possessed originally. Thus the term was first applied in England to taxes on manufactured commodities produced and consumed in the kingdom, as beer, cider, soap, glass, paper, and the like, and in contradistinction to duties or customs on commodities of foreign manufacture and importation; and this distinction is still officially recognized in the fact that special care has always been taken in all British legislation on this subject to make the excise tax as nearly equal as possible to the customs imposed on the same kind of imported commodities. The term is supposed to find its origin also in the circumstance that it was originally the practice to cut off, or "excise," portions of the goods assessed, and take them away in payment of the tax in kind. The first attempt to impose an excise tax in England was in 1525, and failed, as both Houses of Parliament concurred in opinion that it was unconstitutional. After the Restoration, or under Charles II, the attempt was successfully renewed, and the taxes under it were very curiously divided into two classes, and the receipts from the same made personal to the crown—namely, the *hereditary* excise, so called because granted to the crown forever in consideration or recompense for the abandonment by the crown of certain perquisites and privileges; and the *temporary* excise, the receipts of which were only granted to the sovereign for life. The tax was, however, always unpopular in England, being regarded as contrary to the spirit and principles of a just government, and on the accession of William and Mary it was greatly modified and reduced; and it is somewhat curious that a term having such an origin and history should have found a place in the Federal Constitution and be thus recognized as a legitimate form of taxation under a free government. In Great Britain at the present time the only commodities on which taxes designated as *excise* are assessed are spirits, malt, fermented liquors, and chicory, or other substitutes for coffee. But in addition the British system classifies under the head of *excise* its taxes on railways and a few other minor subjects.

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* It is a curious fact that the old idea that imposts and customs, or the right to impose exactions on trade, were, when first imposed, not regarded in the light of taxes but as dues personal to the sovereign, which he had the right to regulate and collect independent of any statute, has recently found reassertion and indorsement in the United States Senate by a leading member of that body from New England, that he did not regard the levying of imposts or customs dues on imported commodities as in the nature of taxes; for, if such levies on trade are not taxes, they are simply exactions of a despotic form of government, represented immaterially either by one man or a collection of men, and for whom or for which no rightful claim of representing or being a government by the people or for the people can be preferred.

The late United States Justice Miller defined an excise tax as "one which is assessed upon some article of property or money or something which is exhausted in the use. It is one which from its essence and nature must be paid in fact by the buyer, or the last man who buys or uses the property, because, whoever has it at the time when the tax is levied upon it adds that amount to the selling price when he comes to dispose of it until the property is consumed. It is a tax upon consumption." (Lectures on the Constitution of the United States, p. 238.)*

In the United States all Federal taxes that are not levied under the tariff and navigation laws are classified under the general designation of "internal revenue taxes."

The term *toll*, formerly in extensive use, and signifying duties on imports and exports, is now nearly obsolete, and restricted almost exclusively in meaning to the charges for permission to pass over bridges, ferries, and roads (turnpikes) owned by the parties imposing them. The courts have held that railroad fares can not be regarded as tolls.

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* "What is the natural and common or technical or appropriate meaning of the words duty and excise it is not easy to ascertain. They present no clear and precise ideas to the mind. Different persons will annex different significations to the terms."—*Paterson, J., Hylton vs. U. S., 3 Dallas, 171, 176.*

A word in very common use in English history, especially when reference is made to fiscal topics, is that of *subsidy*; but its former and present signification are very different. Under the earlier English kings, when the inadequacy of the hereditary or peculiar revenues of the crown to defray its expenditures compelled the monarch to ask pecuniary aid of his subjects, the grants that were made were known as "*tenths*," "*fifteenths*," or the like, according as the exaction of such percentages of certain properties were authorized, and also as "subsidies" and "benevolences." The peculiarity of all such grants was that they were always special and extraordinary, and had no place in any regular system of taxation. Thus, of the reign of Henry VIII it is recorded that Parliament granted subsidies occasionally, but the king, having found a readier way of obtaining money, did not need them—the readier way having been the confiscation of all the property of the religious houses, which included more than half of all the land of the kingdom; and of Elizabeth, that during the forty-five years of her reign Parliament granted twenty subsidies and thirty-nine fifteenths, the balance of needed supplies being obtained from crown lands—as the duchy of Lancaster—and other hereditary revenues. Under the Commonwealth regular taxes on lands and other forms of property were for the first time instituted in England, and these proved so productive that the old methods of percentages, subsidies, and benevolences were discontinued, and with their nomenclature disappeared from English fiscal history.

At the present time the term *subsidy*, in place of designating as formerly a grant obtained by the Government from private interests, has come to mean a grant obtained from the Government, in aid of private enterprises which it is claimed should be encouraged by the state in the interest of the general public, as, for example, the fostering of shipbuilding and ship-using, and the cultivation and manufacture of certain commodities. But this modern use of the word "subsidy" can not, it is said, be referred back to any earlier period than the year 1840.

Of the many other terms and words used in connection with the subject of taxation, there are very few that seem to require special explanation, and the majority of these, although formerly in extensive use, have now become obsolete and passed into history—as, for example, *gabelle*, the term given in France to the tax on salt; *corvée*, a compulsory contribution of labor; and *taille*, or *taillage*, a tax on the supposed profits of agriculturists, and the like. The characteristic of almost all modern *tax* words or terms is indefiniteness; and probably in no other department of knowledge is there such a lack of exactness in respect to definitions. This to a student may seem at first to be a factor of no little embarrassment, and as assimilating him to the condition of the man who couldn't see the forest because of the multitude of trees; but with the exception of the definitions of *tax* and *taxation,* this condition of affairs really constitutes no obstacle in the way of clearly reasoning and determining as to what should be the fundamental principles of taxation.

THE RACIAL GEOGRAPHY OF EUROPE.

A SOCIOLOGICAL STUDY.

(*Lowell Institute Lectures, 1896.*)

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VIII.—THE BASQUES.

THE Basques, or *Euskaldunak,* as they call themselves, on account of the primitive character of their institutions, but more particularly because of the archaic features of their language, have long attracted the attention of ethnologists. Few writers on European travel have been able to keep their hands off this interesting people. Owing to the difficulty of obtaining information from the original Basque sources, a wide range of speculation has been offered for cultivation. Interest for a long time mainly centered in the language; the physical characteristics were largely neglected. The last ten years have, however, witnessed a remarkable change in this respect. A series of brilliant investigations has been offered to science, based almost entirely upon the study of the living population. As a consequence, this people has within a decade emerged from the hazy domain of romance into the clear light of scientific knowledge. Much yet remains to be accomplished; but enough is definitely known to warrant many conclusions both as to their physical origin and ethnic affinities.*

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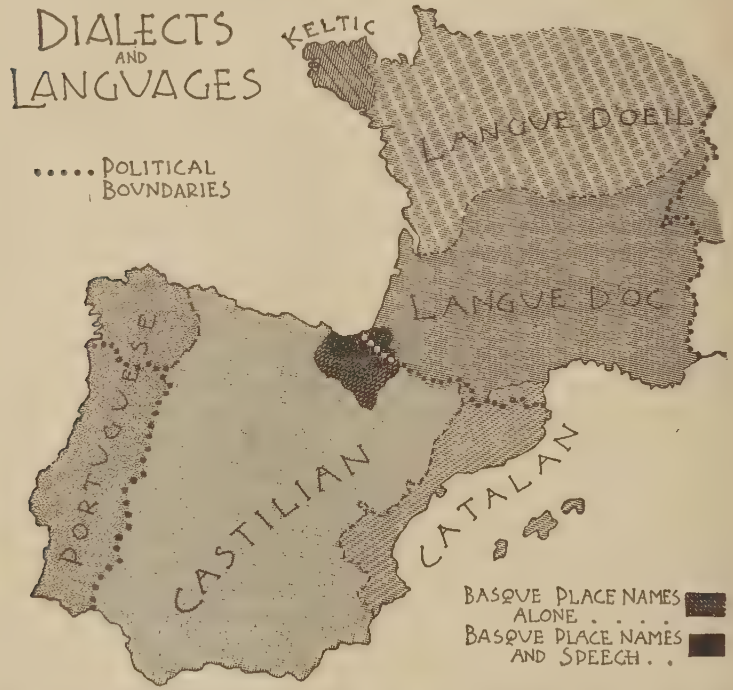
* The best modern authorities on the Basques are Broca, Sur l'origine et la répartition de la langue Basque. Revue d'Anthropologie, series i, iv, 1875, pp. 1–53; R. Collignon, Anthropologie du sud-ouest de la France, Mémoires de la Société d'Anthropologie, series iii, i, 1895, fasc. 4; De Aranzadi y Unamuno, El Pueblo Euskalduna, San Sebastian 1889; Hoyos Sainz and De Aranzadi, Un Avance à la antropología de España, Madrid, 1892; Oloriz Distribución geográfica del índice cefálico en España, Madrid, 1894; and ibid., La talla

Thirty years ago estimates of the number of people speaking the Basque language or *Euskara* ran all the way from four to seven hundred thousand. Probability pointed to about a round half million, which has perhaps become six hundred thousand today; although large numbers have emigrated of recent years to South America, and the rate of increase in France, at least, is very slow. About four fifths of these are found in the Spanish provinces of Vizcaya (Biscay), Navarra, Guipuzcoa, and Alava, at the western extreme of the Pyrenean frontier and along the coast. (See map page 632.) The remainder occupy the south-western third of the department of Basses-Pyrénées over the mountains in France. The whole territory covered is merely a spot on the European map. It is by quality, therefore, and not in virtue either of numbers or territorial extension, that these people merit our attention. In the preceding paper we aimed to


DIALECTS AND LANGUAGES
..... POLITICAL BOUNDARIES
KELTIC
LANGUE D'OEIL
LANGUE D'OC
PORTUGUESE
CASTILIAN
CATALAN
BASQUE PLACE NAMES ALONE . . . .
BASQUE PLACE NAMES AND SPEECH . .

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umana en España, Madrid, 1896. Dr. De Aranzadi has also published interesting material in the Basque journal, Euskal-Erria, vol. xxxv, 1896, entitled Consideraciones acerca de la raza Basca. For ethnography the older standard work is by T. F. Bladé, Étude sur l'origine des Basques, Paris, 1869. The works of Webster, Dawkins, Monteiro, and others are of course superseded by the recent and brilliant studies above outlined.

identify the oldest living population in Europe—a direct heritage from prehistoric times. We found it to lie about the city of Périgueux, shown on our map (page 632). Here, less than two hundred miles to the southwest, is probably the most primitive spoken language on the continent. Is there any connection discoverable between the two? Whence did they come? Why are they thus separated? Which of the two has migrated? Or have they each persisted in entire independence of the other? Or were they never united at all? Such are some of the pertinent questions which we have to answer.

These people derive a romantic interest from the persistency with which, both in France and Spain, they have maintained until the last decade their peculiar political organization; despite all attempts of the French and Spanish sovereigns through centuries to reduce them to submission. Their political institutions were ideally democratic, worthy of the enthusiasm bestowed by the late Mr. Freeman upon the Swiss folk-moot. In Vizcaya, for example, sovereignty was vested in a biennial assembly of chosen deputies, who sat on stone benches in the open air under an ancestral oak tree in the village of Guernica. This tree was the emblem of their liberties. A scion of the parent oak was always kept growing near by, in case the old tree should die. These Basques acknowledged no political sovereign; they insisted upon complete personal independence for every man; they were all absolutely equal before their own law; they upheld one another in exercising the right of self-defense against any outside authority, ecclesiastical, political, or other; they were entitled to bear arms at all times by law anywhere in Spain; they were free from all taxation save for their own local needs, and from all foreign military service: and in virtue of this liberty they were accorded throughout Spain the rank and privileges of *hidalgos* or noblemen.*

Along with these political privileges many of their social customs were equally unique. On the authority of Strabo, it was long asserted that the custom of the *couvade* existed among them—a practice common among primitive peoples, whereby on the birth of a child the father took to his bed as if in the pains of labor. This statement has never been substantiated in modern times; although the observance, found sporadically all over the earth, probably did at one time exist in parts of Europe. Diodorus Siculus asserted that it was practiced in Corsica at the beginning of the Christian era. There is no likelier spot for it to have survived in Europe than here in the

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* For an account of these political rights, see W. T. Strong, The Fueros of Northern Spain, in Political Science Quarterly, New York, vol. viii, 1893, pp. 317–334.

Pyrenees; but it must be confessed that no direct proof of its existence can be found to-day, guide books to the contrary notwithstanding. The domestic institutions are remarkably primitive and well preserved.* Every man's house is indeed his castle. As Herbert puts it in his Review of the Political State of the Basque Provinces, speaking of Vizcaya: "No magistrate can violate that sanctuary; no execution can be put into it, nor can arms or horse be seized; he can not be arrested for debt or subjected to imprisonment without a previous summons to appear under the old oak of Guernica." The ties of blood are persistently upheld among all the Basques. The women enjoy equal rights before the law in many places. Customs vary from place to place, to be sure, and primitive characteristics are not always confined to the Basques alone. They are, however, well represented, on the whole. In some places the eldest daughter takes precedence over all the sons in inheritance, a possible relic of the matriarchal family which has disappeared elsewhere in Europe. It would be out of place to enlarge upon these social peculiarities in this place. It will be enough in passing to mention the once noted mystery plays, the folklore, the dances, the week consisting of but three days (as Webster asserts), and a host of other facts, each capable of inviting attention from the ethnological point of view. The only detail which it will repay us to elaborate is the language. To that we turn for a moment.

To the ordinary observer many peculiarities in the Basque language are at once apparent; *x*, *y*, and *z* seem to be unduly prominent—to play leading parts, in fact. There are more consonants alone, to say nothing of the vowels and double characters, than there are letters in our entire alphabet. For the linguist the differences from the European languages are of profound significance. The Basque conforms in its structure to but two other languages in all Europe, each of which is akin to the linguistic families of Asia and aboriginal America. It is formally like the Magyar or Hungarian; but this we know to be an immigrant from the East within historic times. It is also fashioned after the model of the speech of the Finns in Russia. These people are likewise quite foreign to western Europe; they are akin to tribes which connect them with the Asiatic hordes. The Basque alone of the trio is mysterious as to its origin; for it constitutes a linguistic island, surrounded completely by the normal population and languages of Europe.

In place of inflection, the Basque makes use largely of the so-called principle of agglutination. The different meanings are expressed by the compounding of several words into one, a device not unknown, to be sure, in Aryan tongues; but in the Basque this is carried much further. The verb habitually includes all pronouns, adverbs, and other allied parts of speech. The noun comprehends the prepositions and adjectives in a like manner. As an example of the terrific complexity possible as a result, Bladé gives fifty forms in the third person singular of the present indicative of the regular verb *to give* alone. Another classical example of the effect of such agglutination occurs in the Basque word meaning "the lower field of the high hill of Azpicuelta," which runs

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* E. Cordier. De l'Organisation de la Famille chez les Basques. Complete references in detail by authors will be found in a Bibliography of the Ethno-Geography of Europe shortly to be published in Bulletins of the Boston Public Library.

Azpilcuelagaraycosaroyarenberecolarrea.

This simple phrase is an even match for the Cherokee word instanced by Whitney:

"*Winitawtigeginaliskawlungtanawneletisesti,*"

meaning "they will by this time have come to the end of their (favorable) declaration to you and me." It justifies also the proverb among the French peasants that the devil studied the Basque language seven years and only learned two words. The problem is not rendered easier by the fact that very little Basque literature exists in the written form; that the pronunciation is peculiar; and that the language, being a spoken one, thereby varies from village to village. There are in the neighborhood of twenty-five distinct dialects in all. No wonder a certain traveler is said to have given up the study of it in despair, claiming that its words were all "written Solomon and pronounced Nebuchad nezzar."

Several features of this curious language psychologically denote a crudeness of intellectual power. The principle of abstraction or generalization is but slightly developed. The words have not become movable "type" or symbols, as the late Mr. Romanes expressed it. They are sounds for the expression of concrete ideas. Each word is intended for one specific object or concept. Thus there is said to be a lack of such simple generalized words as "tree" or "animal." There are complete vocabularies for each species of either, but none for the concept of tree or animal in the abstract. They can not express "sister" in general; it must be "sister of the man" or "sister of the woman." This is an unfailing characteristic of all undeveloped languages. It is paralleled by Spencer's instance of the Cherokee Indians, who have thirteen distinct words to signify the washing of as many different parts of the body, but none for the simple idea of "washing" by itself. The primitive mind finds it difficult to conceive of the act or attribute absolved from all connection with the material objects concerned. Perhaps this is why the verb in the

Basque has to include so many other parts of speech. The Arabic language is similarly primitive. It has words for yellow, red, green, and other tints, but no term exists to express the idea of "color," apart from the substance of the thing on which, so to speak, the color lies.

A second primitive psychological characteristic of the Basque is found in the order of the words. These follow the natural sequence of ideas more closely than in European languages. The importance of the idea determines precedence. Thus, instead of saying "of the man," the Basque puts it "man, the, of." Nouns are derived from one another in this manner. From *buru*, head, comes *buruk*, "head-for-the," or bonnet.* Many of the words thus contain traces of their derivation, which have long since vanished from the Aryan. Sayce gives some good examples. Thus *orzanz*, thunder, comes from *orz*, cloud, and *azanz*, noise. The word for month is *illabete*, derived from *illargi-bete*, meaning "moon-full." The first of these two parts is again divisible into *il*, death, and *argi*, light. In this manner we can trace the process of reasoning which induced the combination in many more cases than in our own languages. We still have some, like twilight or *hidalgo*, which in Spanish signifies "son-of-somebody," a nobleman; but these are the exception.

Probably the most primitive element in the Basque is the verb, or the relative lack of it. It was long asserted that no such part of speech existed in it at all. This, strictly speaking, is not true. Most of the verbs are, however, really nouns: "to give" is in fact treated as if it were "donation" or the "act of giving." It is then declined quite like a noun, or varied to suit the circumstances. This is indeed truly primitive. Romanes has devoted much time to proving that the verb requires the highest power of abstraction of all our parts of speech. Certain it is that it is defective in most primitive languages, from the Chinese up. Its crudity in the Basque is undeniable evidence of high antiquity.

The archaic features of these Basque dialects in the days when language and race were synonymous terms led to all sorts of queer theories as to their origin and antiquity. Flavius Josephus set a pace in identifying the people as descendants of Tubal-Cain and his nephew Tarsis. In the middle ages they were traced to nearly all the biblical heroes. Such hypotheses, when comparative philology developed as a science, gave way to a number of others, connecting the Basques with every outlandish language and bankrupt people under the sun. Vogt and De Charency connected them directly with the American Indians, because of the similarity in the structure of their language. Then De Charency changed his mind and derived them from Asiatic sources. Sir William Betharn made them kin to the extinct Etruscans. Bory de Saint-Vincent proved that they were the sole survivors of the sunken continent of Atlantis; of the type of the now extinct Guanches of the Canary islands. Max Müller gives some evidence of similarity to the Lapps, the Finns, and the Bulgarians. Others said the ancient Egyptians were related to them. We have no space to mention more. Little by little opinion crystallized, especially among the historians, about the thesis upheld by Wilhelm von Humboldt, that the Basque was a survival of the ancient Celt-Iberian language of Spain; and that these people were the last remnants of the ancient inhabitants of that peninsula. Pictet was the only linguistic dissident from this view, holding that the Basques were of even greater antiquity; being in fact the prehistoric race type of Europe, antedating the Aryan influx altogether. So much, then, for the conclusions of the philologists. Not very satisfactory, to be sure!

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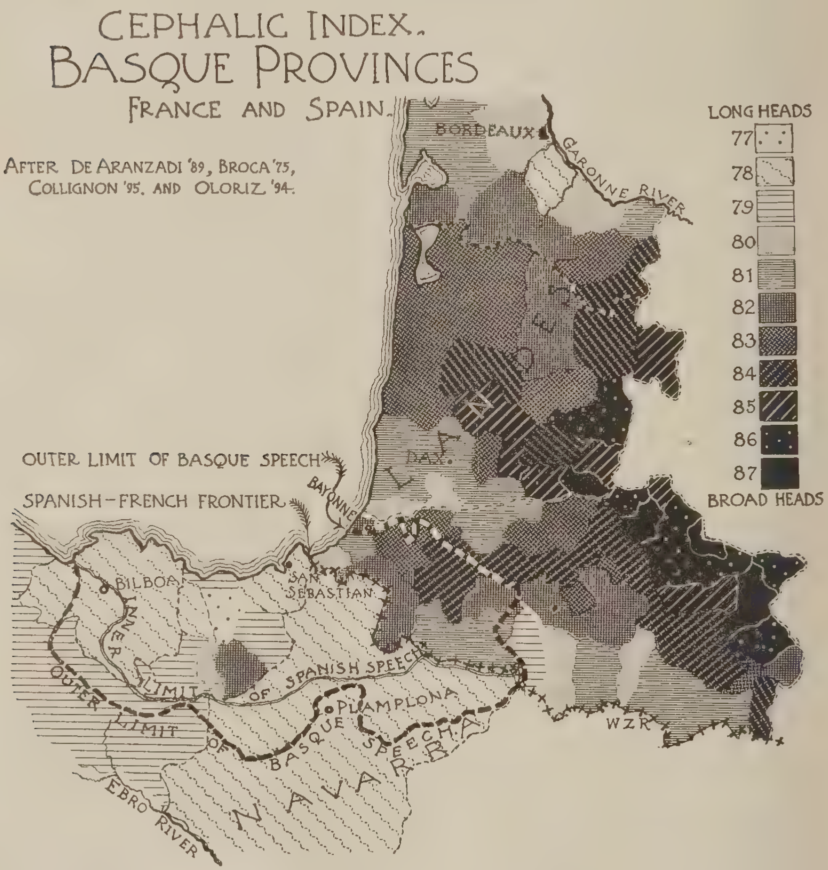
* Good details on the structure of Basque are given by Pruner Bey in Bulletins de la Société d'Anthropologie, 1867, pp. 39–71. Bladé, cited above, also describes fully. Jules Vinson is the best modern authority. *Vide* his Le verbe Basque in recent volumes of the Revue de Linguistique et de Philologie Comparée, Paris.

It will be observed that all these theories rested upon the assumption that racial derivation could be traced by means of language. A prime difficulty soon presented itself. Some thirty years ago the Basque language was found to be drifting toward the north, despite the apparent immobility of the people themselves. It seemed to be losing ground rapidly in Spain, with no indication of doing so, rather the reverse, in France. Nor was this apparently a new development. Everything denoted that it had been going on for many years. The mode of proof is interesting as Broca used it. There are two independent sources of evidence. In the first instance the place names all over Navarra as far south as the Ebro River are of Basque origin; although the language, as our map shows, does not to-day extend nearly as far. This indicates that the Basque speech prevailed when the villages, the mountains, and the rivers were named. No such zone of place names lies outside the speech line in France, save in one canton, just over the Pyrenees. There the Basque place names extend out as far as the broad white line upon our sketch, shown more clearly perhaps upon our other maps. The inward bend of the curve of present speech at this place points to a retrogression of language. Everywhere else in France the division line of place names coincides very closely with that of speech.

No less important proof that Basque is losing ground in Spain but holding its own in France is at hand. Notice on the map that the Spanish language is to-day in use considerably within the Basque limit. In other words, there is an intermediate zone in

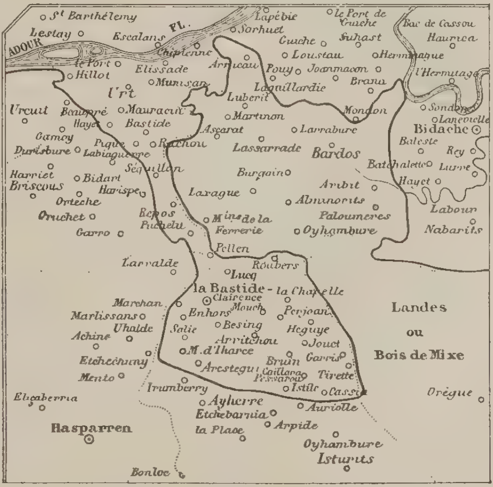
Spain where both languages are understood and spoken by the peasants. This zone varies considerably in width. By the city of Plamplona there is a deep recess cut in the Basque. Castilian being the official language, and Plamplona the capital of the province, the people in its vicinity have been compelled to adopt this language. They have forgotten their native Basque tongue entirely. At Bilbao, also an official city, the Spanish is actively forcing its way in; although the Basque language has more persistently held its own along this side. All along the frontier in Spain the Basque is on the retreat, much of the movement having taken place since the sixteenth century. In France, on the other hand, the Basque tongue holds its own. The line of demarcation between the Basque and the Bearnais-French *patois* is clean and clear cut. There is no evidence of an invasion of territory by the



outsider. This is equally true in respect to customs and folklore; so that the Basque frontier can be detected all along the line from village to village. The present boundary is of such a form that it denotes a complete equality of the two rival tongues. It has remained immovable for many generations.

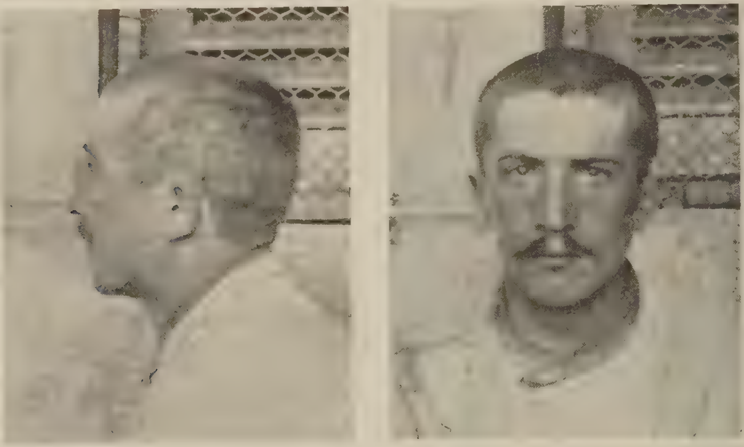
The clearness of this frontier in France is interestingly illustrated by a bit of detail on the accompanying map. It concerns that loop which is roughly indicated upon the larger map just east of Bayonne. Here at the village of La Bastide-Clairence for generations has been a little tongue of Bearnais-French, penetrating deeply into Basque territory. The name of this town indicates a fortress, and another "Bastide" occurs in the tongue farther north. Broca inclines to the view that here was a bit of territory in which the French *patois* was so strongly intrenched that it held its own against the advancing Basque. It may have been a reconquest, to be sure. For us, the sharpness of frontier is the only point of concern, in contrast with the one in Spain. It is an undoubted instance of linguistic invasion toward the north.

Another difficulty, no less insuperable than the fact that their language was on the move in a quiescent population, lay in the way of the old assumptions that the Basques were pure and undefiled descendants of some very ancient people. Study of the head form precipitates us at once into it. No sooner did physical anthropologists take up the matter of Basque origins than they ran up against a pair of bars. Study of the cephalic index yielded highly discordant results. Those who, like Broca and Virchow, measured heads or skulls of the Basques in Spain, discovered a dolichocephalic type, with an index ranging about 79 on the living head. Equally positive were those like Pruner Bey, who investigated the head form on the French slopes of the Pyrenees, that the Basque was broad-headed. The indexes obtained in this



DETAIL—BASQUE-FRENCH BOUNDARY.

latter case clustered about 83. The difference of four units and over was too great to ascribe to chance variation or to defective measurement. The champions of the broad heads, such as Retzius and Pruner Bey, affirmed an Asiatic origin, while their opponents, following Broca, as vehemently claimed that, whatever the Basques might be, they certainly were not Mongolian. They generally asserted an African origin for them. The often acrimonious discussion has been settled finally by proof that both sets of observers were right after all. Strange as it may seem, the people on the two opposite slopes of the Pyrenees, both alike speaking the same peculiar language distinct from all others in Europe, were radically different in respect of this most fundamental racial characteristic. No proof of this, beyond a glance at our map of cephalic index, on page 620, is necessary. From preceding articles the broad heads in France, denoted by the dark tints, will be recognized as the extreme vanguard of the Alpine race of central Europe. Spain, on the other hand, is a stronghold of the long-headed Mediterranean type. Here we have the point of contact between the two. Let us not be confused by the light-shaded area about Dax. That is not truly Mediterranean. It need not bother us. Dr. Collignon identifies it as a remnant of the same prehistoric Cro-Magnon race, centering in Dordogne, which we described in our last paper.

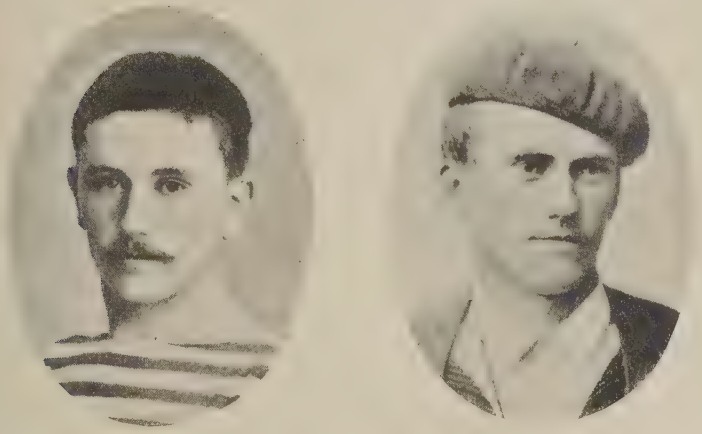


French Basque. Basses-Pyrénées.

Bearing in mind now that the crest of the Pyrenees runs along the political frontier, it seems as if, on the whole, the line of division between broad-headed and long-headed types lay at the northern base rather than along the summits of the mountains.

This is indeed true. Apparent exceptions prove the rule; for where, in the heart of the Basque territory, the broad heads seem to penetrate to the Spanish frontier, there is the ancient pass of Roncesvaux, celebrated in history and literature. The broad-headed type would naturally have invaded here if at all. Everywhere else the long-headed type seems to prevail, not only on the Spanish slopes, but clear over to the foothills of the Pyrenees on the other side in France.*

If these facts be all true, what has become of our Basque physical type? Where are our philological theories of purity of racial representation? If the Basques are indeed an unmixed race, there must be one of these two types which is false. At first the anthropologists sought thus to reject one or the other, French or Spanish, for this reason. Then they laid aside their differences; they abandoned entirely the old theory of purity of descent. The Basque became for them the final complex product of a long series of ethnic crosses. Each of the conflicting characteristics was traced to some people, wherever found it mattered not. The type was compounded by a formula, as a druggist puts up a prescription. Bladé wrote in the light of such views. Canon Taylor, in his Origin of the Aryans, holds that the broad-headed French Basque is only a variation of the Alpine type which we have seen prevails in all the southwest of France, with a dash of Lapp blood. For him the Spanish Basque was, on the other hand, a subtype of the long-faced Iberian or Spanish narrow head. The



Spanish Basques. Tolosa, Guipuzcoa.

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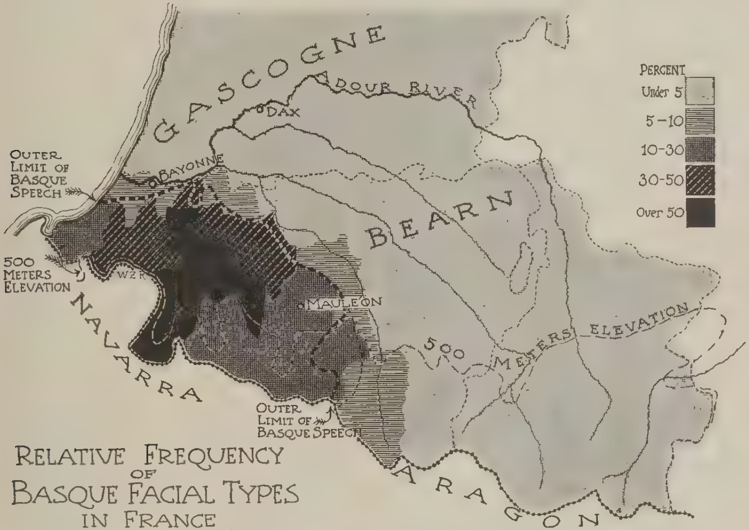
* The general limits of the mountainous country are shown by the five-hundred-meter contour line on our subsequent map on page 625.

result of the crossing of the two was to produce a peculiarity of physical feature which we shall shortly describe—namely, a broad head and a long, narrow face. Aranzadi, himself a Basque, assigns an equally mixed origin to his people. His view is that the Basque is Iberian at bottom, crossed with the Finn or Lapp, and finally touched by the Teuton.

Is there, after all, a Basque physical type corresponding to the Basque language? Enough has already been said to cast a shadow of doubt upon the assumption. Can it be that all which has been written about the Basque *race* is unwarranted by the facts? Let us examine a few portraits collected from both slopes of the Pyrenees. They appear on page 622 and the following pages. At once a peculiar characteristic is apparent in nearly every case. The face is very wide at the temples, so full as to appear almost swollen in this region. At the same time the chin is very long, pointed, and narrow, and the nose is high, long, and thin. The outline of the visage becomes almost triangular for this reason. This, with the eyes placed somewhat close together, or at least appearing so from the breadth of the temples, gives a countenance of peculiar cast. It resembles, perhaps, more than anything else the features of so-called infant prodigies, in which the frontal lobes of the brain have become overdeveloped. The contrast appears especially strong when we compare this Basque type of face with that of its neighbors. The people all about have very well-developed chins and regular oval features, in many cases becoming almost squarish, so heavily built is the lower jaw. A Basque may generally be detected instantly by this feature alone. The head is poised in a noticeable way, inclining forward, as if to balance the lack of chin by the weight of forehead. The carriage is always erect, a little stiff perhaps. This may be because burdens are habitually carried upon the head. On the whole, the aspect is a pleasant one, despite its peculiarities, the glance being direct and straightforward, the whole bearing agreeable yet resolute.

The peculiar triangular facial type we have described—characteristic both of Spanish long-headed or French brachycephalic Basques—has been mapped by Dr. Collignon for the north slope of the Pyrenees with great care. We have reproduced his map on this page. It is very suggestive. It shows a distinct center of distribution of the facial Basque wherein over half the population are characterized by it. Concentric circles of diminishing frequency lie about it, vanishing finally in the plains of Béarn and Gascogne. The most noticeable feature is the close correspondence of this distribution of a physical type with the linguistic boundary. It is exact, save in one canton, Aramitz, at the eastern end southeast of Mauléon. Here it will be remembered was the one spot in France where there was evidence in the place names of a retrogression of the Basque speech before the French. The light-dotted line shows the former boundary. It is the one French-speaking canton, with nearly a quarter of the population of the Basque facial type. The exception proves the rule. Some relation between language and racial type is proved beyond a doubt.

Another significant fact is illustrated by this map. It appears that instead of being refugees isolated in the recesses of the Pyrenees, the Basque physical type is really most frequent in the foothills and open plains along the base of the mountains.



RELATIVE FREQUENCY OF BASQUE FACIAL TYPES IN FRANCE

AFTER COLLIGNON '95

In order to emphasize this point we have indicated the lay of the land upon our map by means of the five-hundred-meter contour line of elevation above the sea. It shows that in the Basque country the mountains are much narrower than farther to the east. The Pyrenees, in fact, dwindle away in height down to the seacoast. The only canton in the mountains proper with upward of half the population of the Basque facial type lies at the famous pass of Roncevaux. At this point the contour line sweeps far south, well toward the frontier. Of the three cantons with the maximum frequency of triangular faces among conscripts, Dr. Collignon found two and a half to be outside the mountains proper. The area of their extension is shaped like a fan, spreading out toward the plain of Béarn. The two wings of the fan are the cantons which form the core of the ethnic group. This region, Basse-Navarre, has always enjoyed a considerable political autonomy. Quite probably the ethnic segregation is due in part to this cause, as well as to the peculiarities of language. This fact that the Basques are not an ethnic remnant barely holding their own in the fastnesses of the Pyrenees, as is generally affirmed; but that they have politically and ethnically asserted themselves in the open fertile country, reverses their status entirely. It confirms an impression afforded by a study of their language that however it may be in Spain, these people are a positive factor in the population of France.

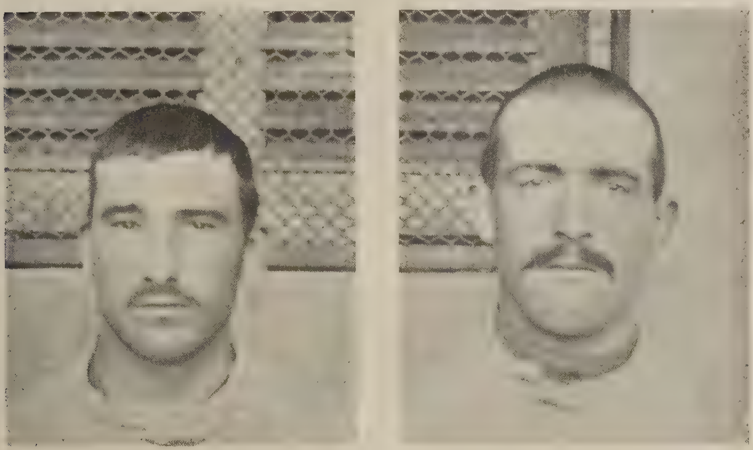
Broad-headed Type. Like the Bearnais.

In reality we have here in the department of Basses-Pyrénées a complex ethnological phenomenon, the Basques constituting the middle one of three distinct strata of population lying on the north slope of the Pyrenees. Our map of cephalic index, on page 620, serves to illustrate this. The plains of Béarn are occupied by the extreme western outpost of the broad-headed, round-faced Alpine type of central Europe. A portrait of one of these is given on this page. Then come the Basques proper, with their broad heads and triangular faces. These lie mainly along the

French Basque. Basses-Pyrénées.

foothills, although at Roncevaux extending back into the mountains proper. Behind them, in the recesses of the Pyrenees, is the third layer of population. These mountaineers are distinctly dolichocephalic. Conscripts with the characteristically narrow head, the long and smoothly oval face, are depicted in portraits on this same page. These last people are really Mediterranean in type, overflows from the true Iberian stock, which forms the bulk of the Spanish population. This ethnic segregation has probably been preserved because of the political independence of the people of the mountains during many generations. These three groups merge into one imperceptibly to the eye; but on analysis their differentiation from one another has now been clearly established.

How has it come to pass that our Basques are thus left interposed between two neighboring populations so entirely distinct in respect of these important racial traits? Is it permissible to suppose that the intermediate zone in which the triangular face occurs most commonly is really peopled by a simple cross between the two ethnic types on either side? This would be similar to Canon Taylor's supposition that a brachycephalic parent stock determined the head form of the Basques, while the narrow lower face and chin was a heritage from a dolichocephalic long-visaged ancestry. Such disharmonic crania arise sometimes from crossing of the two types of head form, especially in Switzerland, where the Teutonic and Alpine races come into contact with one another. An objection to this theory of secondary origin by intermixture is close at hand. It is fatal to the assumption. It is an important fact that the Basques are relatively



MEDITERRANEAN DOLICHOCEPHALIC TYPES. Pyrenees Mountains.

broader-headed than even the neighboring peasantry of Béarn, and of course even more so than the long-headed Spanish population across the Pyrenees. Turning back to our map on page 620, this will appear. Of course, the Basques are not more extreme in this respect than the pure Alpine type; we mean that they rise in cephalic index above their immediate and adulterated Alpine neighbors in Béarn. This implies, of course, that they are at the same time far broader-headed than the Spanish Basques over the mountains. Thus we dispose at once of the explanation offered both by Canon Taylor and De Quatrefages for the broad-headedness of the French over the Spanish Basque. Taylor accounted for this marked difference between the people of the two opposite slopes of the Pyrenees on the supposition that in invading Béarn from Spain the Basques intermarried with the broad-headed Alpine stock there prevailing, and so deviated from their parent type. This fact that we have mentioned, that in France in their greatest purity the Basques are broader-headed than the Béarnais about them, proves beyond question that they are brachycephalic by birth and not by intermixture with their French neighbors. In Spain, on the other hand, the facial Basque, if we may use the term, is slightly broader-headed than his purely Spanish neighbor. Surrounded thus on all sides by people with longer and narrower heads, we are forced to the conclusion that this people is by nature of a broad-headed race. An important corollary is that the pure Basque is to-day found in France and not in Spain, although they both speak the same language. This exactly reverses Taylor's theory. It is the Spanish Basque which is a cross-type—in other words, narrower-headed by four units than the French Basque because of intermixture with the dolichocephalic Spaniards. Those who are found here in Spain are probably stragglers; they have merged their physical identity in that of their Spanish neighbors. Their political autonomy on this south side of the mountains being less marked, the power of ethnic resistance vanished quickly as well.

Having disposed of the explanation of origin by intermixture, the only hypothesis tenable is that these Basques are immigrants —that they are an intrusive people. Dr. Collignon's explanation is so simple and agrees so well both with history and with anthropological facts that we give it as nearly as possible in his own words: During the Roman imperial rule a number of petty Iberian tribes, by virtue of the same tenacity which enables their descendants to enjoy political autonomy to this day, had preserved a similar independence south of the Pyrenees. Such were the Vardules, Caristes, Autrigons, and the Vascons (Basque—by no means physically identical with the Gascons, although derived from the same root word). These last occupied the upper course of the Ebro—that is to say, modern Navarra in Spain. The barbarian invasions ravished all Gaul with fire and sword. The Visigoths, controlling for a time the two slopes of the Pyrenees, were finally expelled from Aquitaine by the Franks, greater barbarians even than they. It is readily conceivable that these Visigoths about this time began to covet the rich territory of the Vascons over in Spain, especially the environs of Plamplona, which were of great strategic importance. History furnishes no details of the conflict, except that the Vascons were completely subjugated and partly driven into the Pyrenees. Here they speedily found their way over into Béarn in France, meeting no opposition since the country there had mainly been depopulated by constant wars. This occupation by the Vascons, according to Gregory of Tours, took place in the year 587—that is to say, some time after the fall of the Roman Empire. The invasion was accelerated later through the pressure exerted by the Spaniards, fleeing before the Saracen conquerors in the south. Remnants of all the Spanish peoples took refuge at this time in the north. Impelled by this pressure from behind, the Vascons were driven out of the Pyrenees and still farther north into France, retaining their political autonomy under Frankish rule. Here they remained undisturbed by the Saracens, save by the single army of Abd-er-Rhaman. Hence on this northern side of the Pyrenees they have preserved their customs and physical characteristics intact, while in Spain intermixture has disturbed the racial type to a greater degree. The language alone has been better preserved south of the mountains because it was firmly fixed there before the Spanish refugees came in such numbers. Of our three layers of present population the dolichocephalic type in the fastnesses of the Pyrenees to-day represents the primitive possessors of Aquitaine. Here, driven to cover by the advancing wave of the Alpine stock on the north long before the fall of Rome, they have remained protected from disturbance by the later invaders from the south. The Vascons or Basques have simply passed through their territory, with eyes fixed upon the fertile plains of Aquitaine beyond. They spread out in two wings as soon as they were out of the mountains, as we have seen. In the course of time they have intermarried with

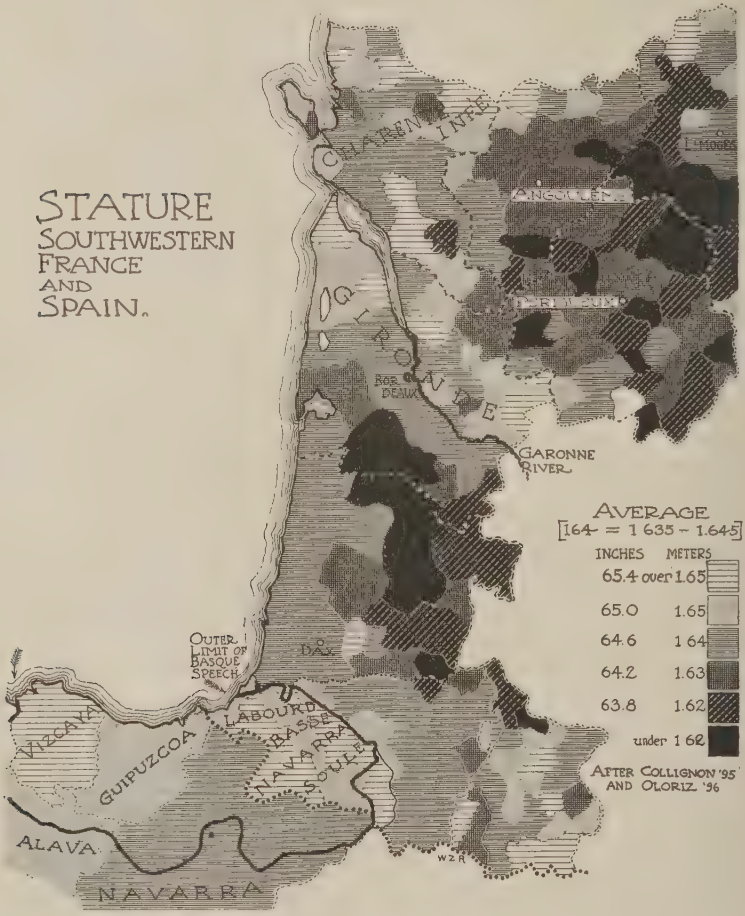
Spanish Basque.
Zamudio, Guipuzcoa.

the primitive population of the Pyrenees; and the latter have adopted the Basque language and customs: for they were penned in by them all along the base of the mountains and had no other option. This community of language and customs could not fail to encourage intermarriage; to the final end that to-day in the mountains the Basque is considerably crossed, as our map shows. In the plains, on the other hand, the line of demarcation of blood is as sharp as that of speech. Purity of type on this side was made possible by the political independence which Basse-Navarre has always enjoyed.

We have still to inquire as to the physical origin of this curious people. We have traced them back to Spain. Whence did they come into this country in the first place? Are they of African descent, following Broca's theory, or are they offshoots from Mongolian stock as Pruner Bey would have it? Or must we class them with the lost tribes of Israel? We already know the physical type of the prehistoric Cro-Magnon race. Let us compare it with our Vascons and test the theory of descent from it. The Basque head is disharmonic—that is, it is broad, while the face is extraordinarily narrow. This is in contravention of the general law that the face and the head usually participate alike in the relative proportions of breadth and length. Thus, as our portraits have shown, the broad-headed Alpine stock in Béarn has a round, short face; while the dolichocephalic population of the Pyrenees, lying behind the Basque, has a correspondingly long, oval visage. The Cro-Magnon race offers the only other example of a widespread disharmonic head in Europe. Are our Basques derived from this pure ethnic source? Curiously enough, these two cases of disharmonism so near to one another cross at right angles. In the Basque the head is broad and the face narrow; in the Cro-Magnon it is the head which is narrow while the face is broad. In view of this flat contradiction, the hypothesis of the Basque as a direct and pure descendant of the most primitive prehistoric population of Europe becomes completely untenable. Thus we dispose of one possible source for this people. We have already rejected those based upon intermixture. The broad head of our Basque with its narrow face is explained by De Aranzadi, himself a Basque, by the supposition of an admixture of Lapp blood to give the broad head with Iberian or Berber blood for the narrow face. Modern research is, however, inimical to such hasty assumptions of migrations across continents and over seas: for the inertia of simple societies is immense. Causes of variation nearer at home are regarded as more probable and potent, and there is none more powerful than social selection.

The difficulty of placing the Basque is solved by Dr. Collignon in a novel and yet simple way which has won favor already among anthropologists. It is of great significance for the student of sociology. His explanation for the Basque type is that it is a subspecies of the Mediterranean stock evolved by long-continued and complete isolation, and in-and-in breeding primarily engendered by peculiarity of language. The effects of heredity, aided perhaps by artificial selection, have generated local peculiarities and have developed them to an extreme. The objection to this derivation of the Basque from the Mediterranean stock which at once arises is that the latter is essentially dolichocephalic, while the Basques, as we have shown, are relatively broad-headed. It appears, however, that the Basque is broad-headed only at one spot, and that far forward near the temples. The cranium itself at its middle point is of only medium width and the length is only normal. The proportions, in fact, excluding the frontal region, are very much like those of the Mediterranean stock in Spain across the Pyrenees. They approach much nearer to them, in fact, than to the Alpine or broad-headed stock. It is thus only by its abnormal width at the temples that the cranium of the Basques may be classed as broad-headed. Dr. Collignon regards the type, therefore, as more or less a variation of the Mediterranean variety, accentuated in the isolation which this tribe has always enjoyed. It approaches in stature and in general proportions much nearer also to the Mediterranean than to the Alpine stock in France.

That the Basque facial type—that which is recognized as the essential characteristic of the people, both in France and Spain—is a result of artificial selection, is rendered probable by another bit of evidence. The Basques, especially in France where the type is least disturbed by ethnic intermixture as we have seen, are distinguishable from their Béarnais neighbors by reason of their relatively greater bodily height. This appears upon our map of stature on page 632. The lighter tints denoting taller statures are quite closely confined within the linguistic boundary. This is not due to any favorable influence of environment; for the Basque foothills are rather below the average in fertility. The case is not analogous to that of the tall populations of Gironde, farther to the north, light tinted upon the map. They, as we took occasion to point out in the preceding paper, are above the average either in Dordogne on the north or in Landes on the south. The contrasted tints show this clearly. These differences are in great measure due to the surpassing fertility of the valley of the Garonne, as compared with the sterile country upon either flank. No such material explanation is applicable to the Basque stature. Some other cause must be adduced. Ought not artificial selection, if indeed it once became operative in a given ethnic group, to work in this direction? Goodly stature is earth-wide regarded as a type of beauty. We know that the Basques are proud of this trait. May they not have evolved it, or at least perpetuated it, by sexual choice perhaps? This, of course, is merely supposition on our part, but it seems to be worthy of mention.*



The development of a facial type peculiar to certain localities is by no means a rare phenomenon. We shall have occasion to call attention to it later in other portions of Europe, particularly where isolation prevails. The form of the nose, the proportions of the face, nay at times the expression, seem to be localized and strongly characteristic. It is easy to conceive of an artificial selection in an isolated society whereby choice should be exercised in accordance with certain standards of beauty which had become generally accepted in that locality. It is merely an illustration of what Giddings, in his Principles of Sociology, aptly terms a recognition of "consciousness of kind"; or as Dr. Beddoe puts it, of "fashion operating through conjugal selection." An example of the effect of selection of this kind in producing strongly individual types is offered by the Jews. They as a race vary greatly in the proportions of the head; and in color of eyes and hair to a lesser degree. Nevertheless, despite all variations in these characteristics the prominent facial features remain always the same. The first, being inconspicuous traits, are allowed to run their natural course; the latter are seized upon and accentuated through the operation of sexual preference for that which has become generally recognized either as beautiful or ethnically individual.

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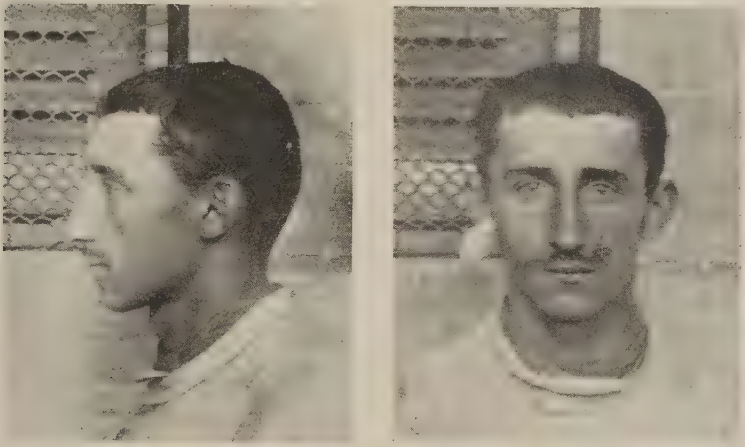
* The apparently contradictory low stature in Spanish Navarra need not disturb us. No attempt was made by Oloriz to differentiate the Basque half of the province from the other. Hence the figures obtained are truly characteristic of neither. The data are defective for all Spain, as compared with the detailed researches of Collignon upon the French side.

In the attempt to justify this interesting sociological explanation for the peculiarities of the Basques, causing them to differ from their parent Mediterranean stock, several corroborative facts have come to light. Certain customs among the peasants seem to imply a recognition of their facial individuality. These all tend to accentuate the peculiarities which have now apparently become hereditary among them. The chin is almost invariably



French Basque. Basses-Pyrénées.

shaven in the adults, with the effect of exaggerating its long and pointed formation. More conclusive still, it is said that in early manhood side whiskers are often grown upon the broadest part of the cheeks. This would obviously serve still more to exaggerate the peculiar form which the face naturally possesses. A neighboring people, the Andalusians, differ in their way of adorning the face in such wise as to heighten the contrast between themselves and the Basques. Among them chin whiskers are grown, which serve to broaden their already rounded chins and to distinguish them markedly from the pointed-chinned Basques. All this fits in perfectly with much of the evidence brought forward by Westermarck, in his History of Human Marriage, serving to show that the fashions in adornment which prevail among various peoples are largely determined by the physical characteristics which they naturally possess. Thus the North American aborigines, having a skin somewhat tinged with a reddish hue, ornament themselves almost entirely with red pigment, heightening still more their natural characteristics. Among the negroes a similar fact has been observed, in each case the attempt being to outdo Nature.

Is it not permissible to suppose that here the same process has been at work gradually remolding the physical type? A far-reaching and bold hypothesis this, to be sure. It would have less probability in its favor did we not observe in modern society many phenomena of fashion and custom closely akin to it in their immediate effects. We have but to suppose a fashion arising by chance, or perhaps suggested by some casual variation in a local hero or prominent family. This fashion we may conceive to crystallize into customary observance, until finally through generations it becomes veritably bred in the bone and part of the flesh of an entire community. A primary requisite is isolation—material, social, political, linguistic, and at last ethnic. No other population in Europe ever enjoyed all of these more than the Basques. If such a phenomenon could ever come to pass, no more favorable place to seek its realization could be found than here in this uttermost part of Europe.

DEFENDING the use of scientific terminology in scientific books, a reviewer in The Athenæum maintains that "those most interested soon become familiar with the meaning of terms, and, experiencing their convenience, adopt them. It is only those who have no real knowledge or interest in the subject who refuse to read a book because they have not mastered the alphabet. We do not think it possible that anybody who would take the trouble to master the structure of half a dozen plant types could remain in ignorance of a considerable amount of terminology, or could express himself rationally without it if he tried."

OBJECTS AND RESULTS OF POLAR RESEARCH.

By GEORG GERLAND

LEAVING out of view the commercial enterprises of the ancient inhabitants of the Iberian Peninsula and the voyages of the primitive Celtic people of Britain, the earliest explorer of the north was a younger contemporary of Alexander the Great, Pytheas of Marsilia, who braved the perils of that region, impelled by purely scientific motives. He returned with abundant results, but was not understood by the people of his time, and more than two thousand years elapsed before men sailed north again in scientific inquiry. It is true that many voyages were made to the north during the middle ages. The Northmen during that period founded colonies in Greenland, in the farthest north, as their countrymen settled in the fair southern regions of Apulia and Sicily; but both sets of settlements failed to be of permanent establishment. The voyage of the Venetian Zeno to the Farö Islands in 1390 was without historical significance, and the voyage of Christopher Columbus beyond Iceland in 1477 is mythical.

At the close of the middle ages, when the deficiency of knowledge of the earth was great, avarice and the quest for the goods of the south led men into the northern ice; they sought to reach India by the shortest possible routes, where they would not meet rivals and enemies. This was the object of Magellan's circumnavigation. The *Ceterum Censeo* of James Lancaster asserted that the way to India was north, around America. India was the object of the polar navigators Cabot in the fifteenth, Frobisher and Davis in the sixteenth, and Hudson and Baffin in the seventeenth centuries, to name only a few of the most famous. It is astonishing what these daring British and Dutch sailors risked, suffered, and gained.

They did not, indeed, reach India, but we all know of Hudson Bay, Davis Strait, and Lancaster Sound. As we owe to the men of the stone age, who lived before all history, one of the most important possessions of man, the great paths they marked out upon the earth across streams, over mountains, and through wilderness and plain, which are still the routes of to-day's highways, so these older arctic navigators mapped out the courses of their successors. The ships of the whalers and seal hunters followed them, discovering one bay, island, and channel after another, naming them and marking them on maps.

In the seventeenth century appeared such men as Kepler, Cassini, Newton, and Boyle. The shape of the earth was actively discussed, improved maps were made, and new aims and motives were conceived, the development of which has caused the nineteenth century to be so sharply distinguished from its predecessors. Now knowledge of the earth is sought for itself, and in this respect the polar research of the present has all at once assumed another aspect, under which it is differentiated from that of the past. Northwestern and northeastern passages have been sought in our days, but not in order to reach India. When Maclure achieved the former in 1852 and Nordenskjöld the latter in 1879, the value attached to the discoveries was not that they furnished routes, but that a correct knowledge of the northern coasts of the two continents and rich stores of other scientific information had been gained by them. Fruits like those, no longer the interests of trade, justified the high prizes which the English Government offered for the discovery of the passage, and the costly expeditions which were dispatched for that purpose. The early trade routes became highways for scientific investigation, and the nature of the polar regions as a whole was inquired into. Such objects were pursued by individuals. Scoresby, while hunting for whales, made constant studies of the highest scientific value of the hydrography, magnetism, and meteorology of the arctic regions; and so did Karl Ludwig Gieseke, afterward Professor of Mineralogy at Dublin, who traveled through East and West Greenland from 1807 to 1813 solely for the thorough study of the geology of their coasts.

Till 1860 the English, and afterward the Americans with them, were in the front as polar explorers. The most important results of their work were the discovery of the magnetic pole in 1831 by John and James Ross, the definition of the coast of arctic America, and numerous single observations. More recently other nations have come forward—the Danes in Greenland, and the Swedes, whose most illustrious representative is Nordenskjöld. Two German expeditions have been sent to East Greenland, an Austrian expedition under Weyprecht and Preyer has discovered Franz-Joseph Land, the Dutch have explored south of Spitzbergen, the Russians on the northern coast of Siberia, and now with Nansen and Mohn the Norwegians have advanced to the very front. In 1882-'83, at the instance of the German Neumayer and the Austrian Weyprecht, a chain of observation stations was established around the pole, to be kept up for a year—an enterprise in which Germany, England, the United States, Russia, Austria, France, Sweden, Norway, and Finland took part. The year 1883 was further marked by Nordensjöld's return from the inland ice of Greenland, and by Nansen's conception of his scheme for traversing Greenland on snowshoes, which he carried into effect the next year. North polar research is therefore almost exclusively the work of the Germanic nations, for the Russian explorers have been chiefly of that stock. The Romanic nations, no less seafaring people, have kept away from the north pole; but France has done something in south polar exploration.

The south pole has been comparatively neglected on account of the unfavorable character of its surroundings. Large masses of land are wanting, and the immense wastes of water of the South offer only a few islands possessing neither large mammals nor human inhabitants; while the Eskimos of the North are of incalculable advantage to exploration. Magellan's southern voyage was not followed up for two hundred and fifty years. The first after him to reach high southern latitudes was James Cook, in 1774, and no other similar expeditions followed for fifty years more. Those best known were those of the French under Dumont d'Urville in 1839, of the Americans under Wilkes, and of the English under James Ross, who in 1842 penetrated to the seventy-eighth degree, the highest southern latitude yet attained. After a year's maintenance of a German station on the South Georgian Islands and of a French station at the southern point of America, both of which belonged to the international system of 1883, and after a few dashes southward in later years, a number of nations —Germany, Austria, England, the United States, and others—are again preparing to co-operate in another polar siege at the austral end of the world for the benefit of science.

The question rises, What is the good of all this effort, this toil, this risk incurred in seeking inaccessible regions? The prospect of adventure, of witnessing strange scenes and experiencing unwonted conditions, of displaying prowess and achieving victory over formidable obstacles, may account in part for the readiness with which individuals are tempted to go into arctic expeditions, but not so with governments. And governments can not expect any practical material gain from such enterprises sufficient to justify the expenditures which they willingly lavish upon them.

Yet there is a real gain in a higher sense to be derived from them. They contribute to the enlargement of our knowledge, to the widening of our circle of view, to the increase of our mental capacity and ability; they make us better acquainted with the planet on which we live, and help us achieve a mastery over it.

Nowhere are more questions to be found for which to seek answers than in the polar regions. Here the magneto-electric light of the earth manifests itself in the wonderful phenomenon of the northern lights. All the wind currents of the earth press toward the pole, and the sea currents too. Curious dispositions of Nature are found here, with great volcanoes, the outer cones of which are constituted of strata of ice covered with lava, and under the masses of ice we discover remains of plants that demonstrate the presence not so very long ago of a flourishing tropical or subtropical vegetation instead of the present ice. We meet mountains of ice everywhere, and everywhere the arctic region is sublime. Man's disposition to make all the earth his home and himself at home everywhere in it is only sharpened by the problems offered there, and the tendency to go becomes irresistible.

There is thus much to observe and much to learn in these regions for the satisfaction of our irresistible longings. First, we are able to study in the polar regions the division of land and sea, the size, elevation, and topography of the land—the whole question, in short, of polar geography. The form of the earth's surface is not casual, but is the result of interactions of the crust and the interior of the globe. The discovery by Nansen's expedition of the profundity of the polar sea tallies with Prof. Mohn's observations of the great depths between Greenland and Spitzbergen and with those of the fiords and interinsular channels of the North Atlantic. Further, the sea bottoms are penetrated by volcanoes, some of them still active—here single, as in Jan Mayen Island, there in groups, as in Franz-Joseph Land and Fire Island. A marked difference exists in this respect between the Atlantic half of the polar regions north of Europe and eastern North America, where disturbance and divisions of the land are the rule, and the Pacific side, north of Siberia and western America, where quiet prevails, with regular coast forms and few islands. The lands on the Atlantic side have, moreover, been gradually rising for an incalculable length of time, and are still rising, while those on the opposite side have until very recently been subsiding. These facts, selected as examples from a great number of phenomena, may serve to illustrate how important is a knowledge of the polar regions to that of the earth as a whole. Its importance is, in fact, quite beyond comprehension.

So the magnetism of the earth, the colored beams of the northern lights, the flickering of their draperies and bands, are of interest far beyond their relations to the earth alone; for the movement of the magnetic elements reflects the processes of the sun's atmosphere, and may be connected with the immense periods of the revolution of our solar system. Man could not refrain from inquiring into the nature and reason of these things even if he would, and hence he is willingly or unwillingly led to the poles, where he is brought into the closest relations with them, and where the explanation of them can be most hopefully sought.

A relation between the northern lights and the weather has been established by repeated observations, and that brings us to another group of phenomena, those of meteorology, which are of interest to the whole earth, and are especially remarkable in the polar regions. An interchange of great wind currents between the equator and the poles is constantly going on, upon which the movements of the atmosphere and the pressure in the intermediate regions are ultimately dependent, and the study of the atmospheric phenomena of the polar regions is indispensable to our proper knowledge of them.

The excess of heat at the equator forces masses of air into the highest regions of the atmosphere; the congestion at the pole, the necessary consequence of accumulation there, forces them back to the earth. On their way through the higher regions these masses are attenuated and cooled, so that, even when condensed at their sinking, they can not overcome the polar cold; and as they bring little moisture, and consequently little cloudiness, the radiation of heat goes on continuously during the long polar night; the more so because snow and ice are extremely good radiators. Hence the extreme cold which Nansen found in Greenland, and which makes that interior a second pole of cold along with that in the interior of Siberia, is fully explained.

Yet the winds contribute to the warming of the polar sea. They drive the waters from warmer regions in wide superficial currents into the higher latitudes, where, being heavier in consequence of their greater content of salt than the fresher water resulting from the melting of the glaciers and the ice and from the outpour of the great Siberian rivers, they sink beneath them to the bottom and keep the temperature of the sea constantly above the freezing point. The colder, lighter water has to give way to these under-sea currents, and flows into the Atlantic Ocean, cooling the American coasts. At the south pole currents flow in from all the seas, and superficial waters spread into all the oceans.

How shall we account for the masses of polar ice, for the immense icebergs, and the glaciation of Greenland? The snowfall of the polar regions is light. The air is nowhere drier than over the cold glacier ice, as is proved every day in Switzterland by the quickness with which clothes dry when hung over it. At the same time the ice is covered with extremely fine, hardly visible snow crystals. If we boil water in a retort which is connected with another vessel containing a piece of ice, all the steam will pass over on to the ice and deposit itself as ice upon it. The same takes place in a larger degree on the earth, where the retort is the warm evaporating water of the tropical regions, the connecting pipe is the upper atmosphere, and the thickening ice is at the pole. Thus, without any rain or snow falling, all the moisture and all the vapor is withdrawn from the atmosphere by this ice and deposited upon it in fine crystals; and as the influx of air is constant and all-pervading, a never-ceasing supply of frost is going on all the time. In consequence of the larger quantity of moisture, the process is still more marked and regular at the south pole. The explanation of the glaciation of the northern part of our temperate zone during the ice age, still unfound, is a matter of great importance, for the present topography of the land was brought out and the organic life of the whole earth was modified by it; and it is the general opinion that the solution of the problem is to be found, if it is found, by the study of the polar regions.

In the period immediately preceding the ice age the polar regions were not covered with ice, but had a rich growth of plants, reaching up even to the glaciers of their mountains, and plants were represented in them which are now known only in warmer countries. This was a very noteworthy time in the history of the earth. Organic life, in the continents at least, was in its greatest extension, and, I believe, specificism and diversity. The forests also were more luxuriant than now. And this was the time when man originated. Upon this came the ice age, during which man was scattered over the whole world, and organic beings were divided according to their capacity to resist the cold into the three great classes of arctic, temperate, and tropical life—a division which probably existed too during the earlier period, but then only locally, as on mountain ranges. The study of the organic life of the poles is therefore of the greatest importance for the understanding of the history of the organic life of our planet; and the more so because the arctic region has always been an important station for the distribution of organisms. The plants and animals of the south polar lands, on the contrary, and of the pointed southern continental terminations have never shown any permanent community with one another. This peculiar feature of the southern continents appeared very early.

Knowledge concerning the origin and spread of peoples may likewise receive valuable contributions from polar research. That is shown by the Eskimos and their wonderful adaptation to that nature which is so destructive to civilized peoples. In this we have a clear demonstration of the maxim which is one of the most important if not the most important law of all organic and human life: that what is to be permanent can be brought about only by gradual, extremely slow formation; never by sudden, immediate transition, or by sharp, violent breach. It is the same in the mental life. It is impossible to create anything new and enduring by simply casting the old away. Only what has connection has permanence. This maxim may be called the fundamental law of all development; and as it certainly prevails for earthly life, so it does for the existence of human society. This principle is illustrated, and is destined to be more extensively so, from observations in the polar regions.—*Translated for the Popular Science Monthly from the Deutsche Rundschau.*

THE GIANT CACTUS.

By Prof. JAMES W. TOUMEY.

PEOPLE in general are but little impressed by the many forms of life, be they plant or animal, with which they daily come in contact. A tree of unusual size, or a flower of exceptional form or color, attracts our attention. It is the unusual in Nature which always catches the eye. The New England boy grows to manhood under the widespreading boughs of the American elm, in sight of grass-covered mountains and winding rivers. The natural beauty of his surroundings is a part of himself. So, also, the Papago Indian sees nothing peculiar in the many forms of life characteristic of the region where he makes his home.

He can not listen to the whispering of the leaves, because the trees of his limited world do not grow them. He knows nothing of tangled woods, but draws his inspiration from the broad, hot, cactus-covered plains and the granite-walled and lava-strewn mountains.

The many and varied species of cacti, which constitute the vegetation most familiar to him, are the most peculiar of all forms of vegetable life to those who live beyond the limits of our arid region. Of all these strange plants the *sahuaro*, or giant cactus, on account of its great size and striking aspect, is the most impressive. We can well imagine the feeling of the early explorers when they first came in sight of these towering plants, so abundant on the foothills contiguous to Salt River Valley, and from where they extend southward far into Mexico. The finest and largest specimens that I have ever observed are growing only a few miles from Tucson, on the foothills of the Santa Catalina Mountains, where hundreds may be seen growing on a single acre, many extending their huge green columns to the height of fifty feet. The many ribs which parallel the columns are surmounted by bunches of heavy spines. With great age the spines fall away from the lower portion of the plant, leaving the broad, obtuse ribs devoid of their natural protector. This fact led the first observers to report the plant spineless.

When lighted, the spines burn readily; the flame, soon ascending, burning the spines in its path until it reaches the top. From this fact the plant is sometimes recognized as the "Arizona candle."

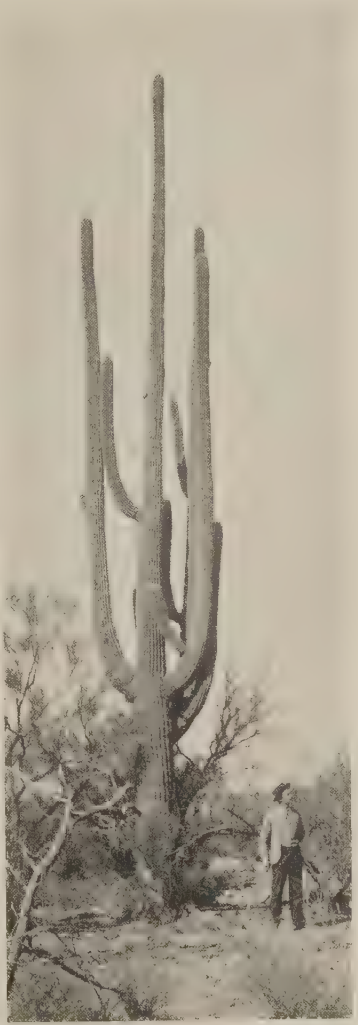
Just beneath the epidermis and alternating with the spiny ribs are strong ligneous fascicles. These fascicles are of the same number as the ribs, and serve as a support for the soft parenchyma tissue which constitutes the great bulk of the plant.

The fascicles are not unlike huge fish poles, twenty to forty feet long and from one to three inches in diameter, flattened radially as relates to their position of growth. This woody portion endures long after the other parts of the plant have decayed and is popularly known as the skeleton. During the growth of the plant the fascicles increase in size each year by the addition of a woody layer to their outer surface, in the same manner as the oak and maple add their annual layers. The layers of growth forming the older fascicles are very close together, sometimes a hundred being crowded into less than an inch of space.

A Cactus Forest.

This portion of the plant is of great value to both Indians and Mexicans, as it not only serves as firewood but is extensively utilized in both fence and house building. When cut to requisite length it makes excellent pickets, and throughout its entire range the dirt roofs of the adobe houses are supported by the long, strong fascicles.

We find by counting the layers of growth that many of the older plants have been more than a century and a half in growing. The size of the plant is not always a fair criterion of its age, as plants eight to ten feet high, growing from the granite rocks on the southern slopes of the Santa Catalina Mountains, are older than plants four or five times larger growing in deep cañons or in yards about the city, where the water supply is not so completely withdrawn. The ability, however, of this plant to withstand prolonged drought is very great. Its enormous mass of succulent tissue, protected by a thick epidermis, enables it to maintain the accumulated moisture for an almost indefinite period, even after every source of outside moisture has been dried up. A plant may be taken up, exposed to the hot, dry air for months, and when replaced in the soil continue to grow, having suffered little apparent injury. Living specimens, weighing several hundred pounds, may be packed in boxes and shipped to Europe and other foreign countries, without injury to their vitality. A few years ago a specimen some eight feet high was placed in the window of one of the Tucson shops. Some eighteen months later it was found on examination to still contain a large amount of moisture. Its vitality is further illustrated by the fact that a foot or more of the top may be cut from the plant in early spring and sent across the continent, flowers developing on the detached portion several weeks after it has reached its destination.



GIANT CACTUS (*Cereus giganteus*). (Engelm.)

A number of birds, including the Gila woodpecker, the red-shafted flicker, and the golden flicker, excavate great holes in the soft tissues in which they build their nests. Later the abandoned houses of the woodpeckers are favorite retreats for the Mexican screech owl and the pygmy owl. An occasional bat, overtaken by sunlight, passes the day in one of these dark holes, and when the excavation extends through, from side to side, the cactus wren brings in its miscellaneous collection of sticks and straws and makes itself at home.

The first flowers appear when the plant reaches a height from eight to twelve feet, and at this time branches develop; usually forming a whorl a few feet below the summit. In the course of a year or two the branches assume an upright position, forming columns parallel to the main stem.

The large, waxy-white flowers are borne in the axils of the bunches of spines, at or a few inches below the summit of the trunk and branches; sometimes a half hundred crowning the summit of a single branch. They begin to bloom during the early days of May, and are not entirely gone before the middle of June. By midsummer the thick stems are loaded with ripened fruit, and the harvest time for both birds and Indians is at hand. The latter, mounted on ponies, pass from tree to tree, armed with long poles, with which they detach the fruit and bring it to the ground. The squaws gather it in baskets and carry it to their village, where it constitutes the staple article of food for the time being. The surplus is made into a preserve having the consistence of thick molasses, and is nearly as sweet. It is then packed in small *ollas* and put away for future use. Not always, however, is the surplus fruit put to this use, but instead is made into a rank, intoxicating drink.

The fresh fruit is not unpleasant, even to the cultivated palate, and is very unlike the slimy, mucilaginous fruits of many other species. At maturity they are fully three inches long and half as wide. In a few days the pericarp, or thick outer rind, splits at the summit into several segments, which, curling back, exposes the rich, red pulpy interior. The segments spreading in all directions appear from a distance like gayly colored petals. As they become more deflexed the central portion falls to the ground, leaving only the pericarp attached to the plant. The edible portion consists of the long, fleshy *funiculi* which attach the numerous small black seeds to the ovary.

Nearly a half hundred birds feed upon the rich, nutritious fruit of this plant, the list including all our thrashers, woodpeckers, finches, and pigeons. It is through the agency of these birds that the seeds become disseminated.

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ESKIMO BOWS AND ARROWS.

By JOHN MURDOCH.

WHEN we landed at Point Barrow, in 1881, it seemed as if every Eskimo hunter had a pretty good rifle. There is a law against selling breech-loading arms and ammunition to "Indians," but it was no better enforced in Alaska than it was in old times on the plains, when the Sioux used to butcher our soldiers with rifles and cartridges made in the Eastern States.

When we grew better acquainted with the natives, however, we found that some of the poorer men were still obliged to depend on the weapon of their forefathers, the bow and arrows. Besides, every boy in the village had his little bow, which he used for shooting birds and small animals. Now, these bows were perhaps the most ingenious piece of bow-making in the world.

As every one knows, the Eskimos, with very few exceptions, inhabit a region which is perfectly treeless, or at any rate where nothing grows but pines and spruces, whose soft, inelastic wood is entirely useless for making bows. They have overcome this difficulty very effectively by fastening along the back of the bow twisted cords of reindeer sinew in such a way that each cord is stretched when the bow is bent and flies back when the bowstring is released. As far as we know, no other race of savages make use of this ingenious contrivance. Some tribes of Indians are in the habit of stiffening their bows by "backing" them with strips of sinew, glued on, but the Eskimo backing is made of cords and tied on. As old Martin Frobisher, the first Englishman who ever saw the Eskimos (in 1577), tells us, "Their bowes are of wood of a yard long, sinewed on the back with strong sinewes, not glued too, but fast girded and tyed on."

In some regions the Eskimos when first visited by white men were still using bows with a very simple backing, merely twenty or thirty strands of twine running from one end of the bow to the other, twisted together tightly from the middle, and tied down to the bow in two or three places. My friends at Point Barrow and along the adjacent coast, however, had gone on improving the bow until it was the best made by Eskimos anywhere.

The body of the bow was made of a piece of good sound spruce driftwood, from forty to fifty inches long, an inch and a quarter wide, and three fourths of an inch thick in the middle. It was very carefully and neatly made, trimmed down beautifully smooth with the crooked knife, the Eskimo's universal tool, with which he does such very clever whittling. Like all bows, they were flattened on the "back" and rounded on the "belly" and tapered off toward the ends, where they were worked into neat "nocks" for the bowstring. Some bows were straight, and some turned up at the ends like a Tartar bow.

Now, to "back" such a bow as this they would take one piece of twine, forty or fifty yards long. This twine is made of a three-ply braid of reindeer sinew, about the size of common twine such as we use for tying parcels, and serves the Eskimos for a great variety of purposes. One end is looped round one nock of the bow, and about twenty strands are strung up and down the back of the bow, from one end to the other. Then they began to lay on strands that ran only between the weakest parts of the bow—that is, the points about half a foot from each end. Here these strands were fastened with very complicated hitches, making a sort of "whipping" round the bow. When there were enough strands put on to make a couple of cords about as big as a lead pencil, an ingenious tool was used to twist each up tight from the middle, and the whole was whipped down securely with the end of the cord. It is easy to see how drawing the bow would stretch these twisted cords and make them fly back with great force when the string was released, while all these lashings and whippings not only hold the cords tight to the bow, but also compress the fibers of the wood like the whippings on a fishing rod, and prevent cracking. The hitches and knots, besides, are put on in such a way that straining the backing draws every lashing tighter. The bowstring was also of the same plaited sinew.

The arrows were very neatly made of some light wood, and feathered with two or rarely three narrow feathers, generally made from the quill of some bird of prey, and neatly lashed on. They had four kinds of arrows. The bear arrow in old times always had a regular flint arrowhead, made by flaking, such as so many savages used, and which are found in such quantities all over the country wherever the Indians used to live. They still preserve the art of making these at Point Barrow, and made a number of beautiful arrow points for sale to us. But they never learned how to make a flint arrowhead with barbs, and so they sometimes made their bear arrows with a barbed head of bone tipped with flint. Driven by such a strong bow these arrows were very effective, and, if no bone was in the way, were sometimes driven clean through the body of a polar bear. As they came more in contact with white men, they took to tipping both kinds of bear arrows with bits of metal, brass, iron, or steel when they could get them. I brought home a couple of arrows tipped each with one blade of a pair of scissors, filed into an arrowhead.

For hunting the reindeer the arrow had a long, sharp, bayonet-shaped head made of antler, barbed on one edge and fitted loosely into the shaft. As the Eskimos told us, when they hit a deer with one of these arrows the shaft could drop out, leaving the barbed head in the wound, and the deer would go off, "sleep one night, and then die."

Geese, gulls, and other large fowls were shot with arrows that had long, five-sided heads of walrus ivory, not very sharp and barbed on one edge, while for hunting small birds they used an arrow with a blunt, club-shaped head made of reindeer antler. Such an arrow kills a small bird or little animal like a lemming or ground squirrel by stunning it, and does not tear a great hole in it. The boys' arrows nowadays are often headed with empty copper cartridge cases, and I have seen one of these shot clean through the body of a small bird.

The bow was carried, strung ready for use, in a sheath of tanned sealskin slung across the shoulders in such a way that it could easily be drawn out under the right arm. Nowadays they carry their rifles in similar sheaths.

Attached to the sheath was a quiver, also of sealskin, in which they used to keep an assortment of arrows, some of each kind, according to the hunter's needs.

All the Eskimos draw the bow like European archers—that is, by hooking the fore and middle fingers round the bowstring, with the arrow clasped between the fingers, instead of pinching the butt of the arrow between the finger and thumb, like most Indians.

As the bow is now practically nothing but a plaything among the Eskimos of the Northwest, it will probably not be many years before it entirely disappears, as it has in Greenland.

PUTTING aside "supposed portraits" and such as might be termed "fancy portraits" having no claim to authenticity, Mr. W. Carruthers has satisfied himself of the existence of eight portraits of Linnæus that were evidently painted or drawn from life, and have been copied more or less frequently by different engravers. The earliest was painted by Hoffmann in 1737, while Linnæus was working for his patron, Cliffort, at Hartecamp, and represents him at the age of thirty in the picturesque dress in which he traveled through Lapland. Of the next portrait, an engraving by Ehrensverd in 1740, no original is known to exist. In 1747 two pencil sketches of Linnæus, forty years of age, one sketch being a full length, were made by Rehm. Five years later a fine pastel was executed by Lundberg. Scheffel, in 1755, painted him at the age of forty-eight; and this portrait was painted by Krafft, and was placed originally in the Medical College of Stockholm, of which Linnæus was one of the founders. It was supposed to be lost, but had been removed to the Royal Academy of Sciences at Stockholm, where Mr. Carruthers discovered it. The latest portrait was that by Roslin, painted in 1775, when Linnæus was in his sixty-eighth year. A fine copy of this by Pasch, presented to Sir Joseph Banks, and given by him to Robert Brown, hangs in the library of the Linnean Society.

WHEN CHARACTER IS FORMED.

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I.

THE results of late researches in physiological and experimental psychology contribute much toward a rational explanation of the causes of abnormal and deficient mental characteristics in childhood. To begin with, it is now satisfactorily shown that mental action is accompanied by the expenditure of energy derived from the breaking down of highly unstable chemical compounds in cerebral nerve-cells. The brain has come to be regarded as a storehouse of nerve power; and when too severe or prolonged demands have been made upon it the cells become much depleted of their contents, and there results a condition of brain tire or fatigue. The process of depletion has been studied with great care in the case of the frog by Dr. Hodge,* of Clark University, and some of his results are shown in the accompanying Diagram A.

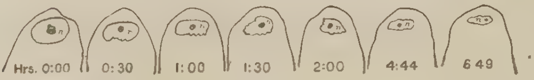

DIAGRAM A, showing changes observed in the nucleus of the living sympathetic nerve cell of the frog, as the result of direct electrical stimulation (Hodge, after Donaldson †). After six hours and forty-nine minutes of stimulation, the nucleus (*n*) is seen to be reduced to less than one half its size when the stimulation began.

While no similar observations have been made upon human beings, for obvious reasons, yet it seems reasonable that the same law holds here in regard to the expenditure of nerve energy by physical or mental work.

It is evident that the law of the conservation of energy is implied in this phenomenon, and the accompanying diagrams may serve to make clear the method of its application. In Diagram B there is shown leading to the very heart of the nerve cell a filament, N, whose office is to carry messages in the form of stimuli from the world without; and leading from each cell are a number of avenues or passageways, D, through which may run off to other cells or muscles the energy set free by the advent of some sense stimulus or by the processes of thought and feeling. A very slight stimulus may in certain instances unloose a relatively great amount of energy which may be expended in thought and emotion, or which may issue directly in movement. Every one knows that a mere whisper of the death of a dear friend or of an approaching calamity or any similar circumstance will create great mental disturbance and drain the nerve cells to the point of exhaustion. So the prick of a pin or a tickling of the sole of the foot will produce vigorous movements of the entire body in most persons. It is probably true that in almost all instances the physical or mental resultant of a given stimulus is far greater, from the point of view of energy expended, than the stimulus itself. Every stimulus entering the cerebral cells is re-enforced from the energy stored therein; and it is plain, of course, that the less the supply or the greater the demands made the more rapidly will exhaustion follow. In a study, then, of brain fatigue in childhood we have to consider first the conditions which determine the amount of energy which shall be stored in the cells, which, as we shall attempt to show, differs in individual cases on account of a variety of varying circumstances; and, secondly, we have to regard the character of the work done, so as to notice how heavily it draws upon the credit of the brain.

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* For a detailed description of the method of making the study, with results, see Hodge, Some Effects of Electrically Stimulating Ganglion Cells. American Journal of Psychology, vol. ii, p. 3 *et seq.*

† The Growth of the Brain, p. 320.

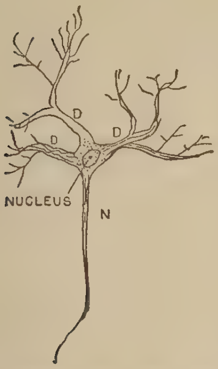

Diagram B, from Starr, Atlas of Nerve Cells, page 39, modified especially to show nucleus which is depleted of energy when the cell is in action.

It is the purpose here to consider especially the intellectual and emotional concomitants of brain fatigue in childhood. In order to ascertain these we may employ any or all of several methods of inquiry. In the first place, we may make direct mental tests to determine if a child can think as rapidly and logically in a state of fatigue, occasioned by overwork or by lack of food, as when refreshed after rest or proper nutrition. In the second place, we may by introspection observe the effects of fatigue upon our own processes of thinking and the character and quality of our feelings. Third, we may study children in their everyday work and play, and observe the influence upon their thinking and feeling of prolonged periods of activity, of great excitement or overstimulation of any sort, of a lack of proper and sufficient food, and other like conditions. Again, we may by observation, and by experiment with apparatus,

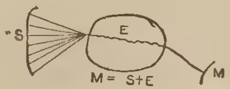

Diagram C.—S = stimuli pouring into the brain (E) through all the senses, and issuing in mental action or movement (M). It shows that the energies of the brain are being drawn upon continually to re-enforce the stimuli from the outer world.

determine the effect of brain fatigue upon physical power and control and make inferences therefrom respecting thought and emotion, since there is little doubt that good physical control indicates a well-balanced and hence a well-nourished brain, which in turn is the essential requisite for well-balanced thinking and feeling. On the other hand, a lack of control in the body as a whole or special members thereof is indicative of an impaired state of the brain, and this impairment must interfere with vigorous, connected thought, and give rise to more or less abnormal feelings. It follows from these propositions that the character of an individual's movements is an index to his brain condition, and indirectly to his mental constitution, aptitudes, and possibilities.

As a result of considerable investigation * of late, according to these various methods of study, it has been shown that, as might be expected, fatigue interferes in the first place with the keenness and integrity of one's intellectual processes. The power of continuous attention is lessened, the rapidity and accuracy of perception through every sense are dulled, memory becomes halting and uncertain, and reason grows illogical and erratic. The writer has studied during the past year the influence of brain fatigue upon school children in Buffalo by observations made during the regular work of the day, and by simple experiments with apparatus designed to test first, the rapidity of thought and action as determined by the length of reaction time upon stimuli presented to the different senses; second, the keenness and accuracy of sense perception; and, third, the power of control of the body as a whole, and of the different parts, as the hand, the tongue, etc.† He has also tested the elementary intellectual processes according to methods devised by Dr. Joseph Jastrow, wherein the ability to perceive and judge of form

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* For detailed results of some of the most important of these researches, together with careful and complete descriptions in many cases of the methods of study employed, see the following: Cowles, Neurasthenia and its Mental Symptoms; Mercier, The Nervous System and the Mind; Donaldson, Growth of the Brain, pp. 277–323; Francis Galton, Journal of the Anthropological Institute, 1888, p. 153; Warner, Mental Faculty, p. 76; Dresslar, Fatigue, Pedagogical Seminary, June, 1896; Kraeplin, A Measure of Mental Capacity, Popular Science Monthly, vol. xlix, p. 756; Sinclair, Schoolroom Fatigue, Educational Foundations, May and June, 1896; Bryan, The Development of Voluntary Motor Ability; Gilbert, Studies upon School Children in New Haven, in Studies from the Yale Psychological Laboratory, vol. ii.

† It will not be possible here to give a description of the apparatus employed, with illustrations and details respecting methods of use, but the reader, if interested, can obtain complete information relating to most of the apparatus by referring to Scripture, *op. cit.*, as follows: For the apparatus used in testing rapidity of thought and action, see pp. 27–37; also pp. 43, 46, and 58. For the apparatus employed in testing the keenness of the senses, see pp. 101–112; also pp. 124, 135, 139, 141, and 170–173. For that employed in determining physical control, see pp. 67–74, 79, 80, 86, 87.

readily and accurately, to retain and reproduce visual impressions, and to identify new impressions similar to others recently experienced, is detected.* These experiments test in a way at least the processes of attention, perception, retention, and comparison or reason; and because of their simplicity, not being complicated with other factors, it is comparatively easy to detect varying power on the part of the pupil.

Space will not permit a detailed statement of the results of these studies, but it may be said in summary that after two and a half hours' work in the schoolroom almost all pupils show a decrease in intellectual power. Reaction time is considerably lessened—the pupil can not perceive and react so quickly or with such surety. He can not discriminate colors with such keenness. If in the morning he can detect a gramme pressure upon the back of the hand, he now requires two grammes or more in order to receive an impression. If when he is refreshed he can detect two points upon the back of the hand thirty millimetres apart, they must be separated considerably in order to be detected as two when he is in a state of fatigue. In a test of physical control the hand will be found much less steady after a few hours of mental labor, as may be seen by examining one's handwriting with a magnifying glass. If the pupil endeavor to perform some difficult task requiring great co-ordination of the different parts of the body, as in directing a light rod upon a small point a few feet away but yet within easy reach, or in threading a fine needle, the influence of fatigue is easily observed. In the laboratory a device is used whereby an electric bell is rung when a given point is not touched. In testing a pupil in this way it has often been found that he can not only not touch

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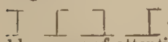
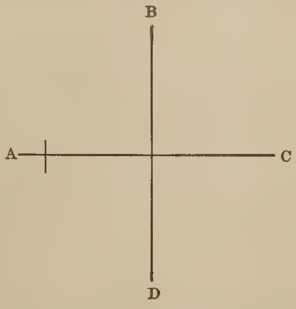
* The ability to perceive and judge of form is tested first by dividing a line of a given length, say three inches, into any desired number of equal parts; second, by marking off on lines B C D a distance equal to that on A; third, by singling out and marking a certain form, as , mingled in with many more similar forms, as . This work requires considerable power of attention and discrimination.



Retention and reproduction of visual impressions is tested by having the pupil examine for about two minutes a card containing fifty pictures or words, each being accompanied by a number; then on a card containing ten pictures or words selected from the fifty the pupil is to set down the appropriate number opposite each, being allowed only a brief period for this—say one minute. To test the ability of identification the pupil examines for one minute a card with ten words or pictures, and then either immediately or some time after identifies and marks these in a group of fifty words or pictures.

the point so often in a state of fatigue as when rested, but the strain seems much greater upon the whole body, causing twitching and other choreic movements if continued very long. This evidence all points to the fact that mental activity expends nervous energy which is revealed in lessened muscular control. So in the direct mental tests, a pupil can not after a half day's work in school do such an apparently simple thing as to divide a line into a given number of equal parts with the accuracy that he can earlier in the day. The same effects of fatigue are evident in the lessened power of retention of visual images, and of identification of similar impressions. In short, fatigue lessens mental ability; produces, relatively speaking, dullness, stupidity, and inaccuracy in thinking.

Substantially these same results have been reached in experiments made by Professors Burgerstein,[*] of Vienna, and Kraeplin,[†] of Leipsic, and at Leland Stanford Junior University[‡] in our own country. Mr. Galton[#] has secured statements from adults to the effect that a hard day's work lessened the keenness and trustworthiness of their intellectual operations. They could not perceive so accurately, remember so readily, or reason so efficiently. Mr. Sinclair,[‖] in his studies of schoolroom fatigue, has obtained similar data.

The statement was made in a previous paragraph that people differ greatly in the readiness with which fatigue ensues upon mental effort. The nerve cells seem to be so constituted in some people that they give off an undue amount of energy upon slight stimulus.[^] This fact may be easily observed in a group of children as well as among adults. A slight noise, a touch upon the shoulder, or a sharp question will cause some to react with an amount of vigor quite out of proportion to the degree of the stimulus. The body will twitch, the face flush, and the thought will be confused. Other children will show none of this excessive display of energy. Their reaction is proportionate to the stimulus, and in this way they save their energies. Consequently, other things being equal, they endure much longer and can undertake more difficult and trying ordeals without fatigue. Again, it is easy to see when any number of children are gathered together that some have much more energy always at their disposal than others. In other words, they are better nourished, which means in this connection that they have more nerve energy that may be employed in either mental or physical work. The important point to be noted here is that some children, from whatever cause, may be in a more or less constant state of fatigue all or most of the time; and since fatigue produces what is called dullness, these unfortunates will be distinguished as dullards and stupids, unless the greatest care be taken in home and school to conserve their nervous energy. If such care is not taken, a chronic condition is established in the nervous system which permits the energy to escape in useless ways; and if this continues long enough, perhaps through the college period, it is doubtful if the individual will ever fully recover, since the nerve cells probably acquire their permanent modes of action by this time.

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[*] See Kraeplin, *op. cit.* [†] *Op. cit.* [‡] Pedagogical Seminary, vol. iii, p. 213 *et seq.*

[#] *Op. cit.* [‖] *Op. cit.*

[^] *Cf.* Bryan. The Development of Voluntary Motor Ability. Proceedings of the Department of Superintendence of the N. E. A., 1897.

Thus far nothing has been said of the effects of fatigue upon emotional states. It is manifestly much more difficult, if at all possible, to obtain data respecting this question by scientific experiment; we must rely rather almost wholly upon observation. Doubtless every one has had sufficient experience to be assured that irritability is in many persons an almost certain consequence of unusually severe mental strain or worry.* It has already been pointed out that in a state of fatigue the nerve cells are unstable, giving off energy—exploding as it were—without sufficient cause. A person who when refreshed and vigorous would be able to inhibit impulses to anger, or quick words, or passion of any sort, would probably in a state of fatigue lose this power, at least in a measure. That is, fatigue in most instances lessens the inhibitory action of cerebral cells, and the individual reacts upon every stimulus without, as we say, deliberation or consideration. It is shown, too, by some investigators † that fatigue produces a melancholy, depressed feeling; causes one to turn his thoughts in upon himself, and to become morbid and gloomy if this self-consciousness is long continued. Further, it is the opinion of those who have had large experience that those qualities of character which are described by the terms vicious or criminal are due to perverted feelings dependent upon impaired physical conditions, ‡ especially of the nervous system. It has become a maxim that a man in a state of hunger is much harder to govern than when he is well nourished. Untruthfulness, which Kant has called the negation of self, is generally a characteristic of an individual who has not vigor enough to face boldly the consequences of his acts. It would doubtless be within bounds to say that in general one who is physically weak, who is nervously depleted, is usually, although perhaps not always, morally weak.

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* *Cf.* Warner, *op. cit.*, p. 76.

† E. g., Beard, Cowles, Dresslar, *op. cit.*

‡ See Collin, Papers in Penology, 1891, pp. 27, 28; also Wey, in same, pp. 57–69; Wright, American Journal of Neurology and Psychiatry, vols. ii and iii, pp. 135 *et seq.*

Dr. Stanley Hall has said somewhere that the time may not be far away when we can say that what is physiologically right is morally right—that is, whatever begets the best physiological conditions will produce the best moral character.

II.

If brain fatigue interferes with the readiness and accuracy of one's intellectual operations and estranges the emotional nature, it is important to know what are the agencies most commonly found in home and school which produce this condition; for when the various qualities of which dullness and irritability are types are characteristic of one's childhood they tend to become permanent, thus determining one's character. It is shown by neurology that any mental act oft repeated leads to the establishment of correlated neural processes which make the reproduction of that act continuously easier until it becomes automatic, when all the causes which originally produced it even if with conscious effort on the part of the individual will in time awaken it without any such difficulty. If now it be remembered that brain fatigue is due to some degree of exhaustion of cerebral cells, it will be apparent that one of the most important sources of fatigue is inadequate nutrition of the brain. Nerve cells, like all other cells in the body, repair themselves by absorbing from the blood those materials suited to their particular needs. If the blood does not carry to them a sufficient quantity of the right elements of food to meet the demands made upon them, then while thus neglected they will be in a partially exhausted state from sheer inability to obtain nutriment. Just so a field of wheat in poor soil will bring forth imperfect grain, or a fruit tree unable to find the proper elements of nutrition will bear defective apples or pears or peaches.

All life of whatsoever kind requires a proper sort and adequate amount of nutrition in order that it may develop in a vigorous, healthy manner. Experiments have been conducted in rearing tadpoles and pond snails in various sized vessels of water, where the opportunities for nutrition corresponded with the quantities of water inclosed, and it has been found that the less the amount of water the smaller the animal. Animals reared in this way may be arranged in a series increasing in size according to the quantity of water in which they have been placed.* Many mammals and birds are found to have their centers of distribution in the northern regions, and they diminish in size from the northern to the southern latitudes, thus indicating that the ability to obtain food determines the degree of development of the bird † or animal. Bowditch * has shown in his studies upon the growth of children that native-born Americans are larger and better developed than those of foreign parentage, and ascribes the reason to the better conditions which surround the American children. So children from the non-laboring classes are larger than those from laboring homes.†

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* Donaldson, *op. cit.*, p. 139.

† Ibid., p. 59.

While these data show only the dependence of physical development upon nutrition, still we are not without similar evidence showing that mental development depends also upon the character and amount of a people's food. The causes for the intellectual and temperamental differences between the races of different countries may be ascribed, at least in part, to the character of their dietaries. Contrast the Chinese and English, for instance: the former are mentally and emotionally very different from and inferior to the latter, as might be expected from the quality of their food. The difference between these two races is typical of the difference between types of children to be seen frequently in home and school. The one is slow and obtuse intellectually, and possessed of an indifferent or negative emotional and moral nature; while the other is keen and vigorous in thought, and positive in emotions and morals; and one who strives by concrete observation to account for these differences can not fail to see plainly ofttimes that they are due to the quality and quantity of food which the children eat.

It is important to note that cerebral nerve cells demand particular materials for their proper nutrition. Food which will make bone will not be best suited to the nourishment of an active brain, and *vice versa*. So fat-producing foods, while of course of value in one's diet, yet do not furnish in large measure nutrients for the repletion of nerve cells. Prof. Ladd says that the chemistry of the nerve cells is in the main protoplasmic, and therefore rich in albuminous bodies. ‡ And again, "Of the solids composing the nervous substance, more than one half in the gray and one fourth in the white consist of proteid or albuminous bodies." # The foods that are best calculated to nourish the brain, then, are those containing a large amount of protein or albumin, rather than fats, carbohydrates, or minerals, the three other important constituents of foods. But in many homes, as well in those of the rich as of the poor, the children's dietaries contain comparatively little albuminous food, as may be seen from the following analysis of the nutritive values of the various common articles of a child's diet: Beef contains 29·7 per cent of protein; chicken, 19·3 per cent; fresh fish, about 16 per cent; salt cod, 27·6 per cent; rolled oats, 16 per cent; wheat flour, 12 per cent; Graham flour, 14 per cent; beans, 22·2 per cent; while such vegetables as beets, cabbage, corn, celery, lettuce, potatoes, tomatoes, squash, etc., contain on an average not more than 1·5 per cent of foods that nourish the brain. Pie, pudding, cake, cookies, and crackers contain at the outside not over six to seven per cent, even when these are so cooked that the little substance they contain may be extracted in digestion.* The writer has ascertained the bills of fare of many school children by direct observation and by having them write out the customary articles of diet with mode of cooking, and he has found, what is doubtless already well known, that in many homes the children live quite largely upon vegetables, white bread, and pastry and cakes of various kinds. Parents are ofttimes satisfied if their children eat a large amount of such things, thinking it is primarily the quantity, not the quality, which is to be considered in securing nutrition. As a consequence, those children that live largely upon a starchy diet are in a more or less constant state of brain exhaustion, and they will be liable to manifest all the evidences of fatigue which have been described in preceding paragraphs.

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* Eighth Annual Report of the Massachusetts State Board of Health, p. 295.

† *Cf.* Herbert Spencer, Education, New York, 1884, pp. 226, 227.

‡ Outlines of Psychology, p. 15.

# Ibid., p. 12.

It happens frequently in the homes of the well-to-do, where the expense can have nothing to do with the matter, that the children are permitted to live almost wholly upon those foods which seem to delight the palate, as cookies and cakes in a variety of forms, but which contain relatively little nutrition, the principal ingredient being starch in the form of wheat flour. It is the practice often to begin in the early months of a child's life to feed it highly seasoned and sweet foods, thus establishing an appetite which later is not satisfied with the simple nourishing meats, grains, and milk. In the poorer homes, in our cities particularly, many are unwise in the expenditure of what money they can spare for food, purchasing mainly starchy foods, which, although of relatively little value anyway, are yet more suited for the adult engaged in out-of-door labor than for a child at mental work in school.† Usually in such homes children eat the same food that is prepared for the father of the family, whose labor involves only the use of his muscles, and greater thought is taken in providing for his needs than for those of the children. And then so slight attention has been given by most people to the subject of foods for human beings, although many intelligent men pride themselves in knowing what is best for their horses and cattle, that they do not discriminate between the relative values of different articles. For the most part our tables are thought to be abundantly provided for when they are supplied with a large quantity of food, even though this be of a non-nutritive character, considering the special needs of those who are to partake of it. The art of cookery, too, is so little developed among us that even when food has potentially nutritive value it is not infrequently destroyed in the process of preparation, or is rendered so invulnerable that the stomachs of the children are too feeble to have any effect upon it. Either or all of these conditions are sufficient to keep the brains of many children poorly nourished, and as a consequence such will show evidences of dullness and of the various temperamental disturbances which accompany a lack of proper nerve nutrition.*

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* Dietary Studies at the Maine State College in 1895, published by the United States Department of Agriculture, Bulletin No 37, pp. 11–17. See also Prof. Atwater's Analyses, published by the Department of Agriculture, Bulletin No. 23; and Meats: Composition and Cooking, Bulletin No. 34.

† Atwater (*op. cit.*) gives quite a number of dietaries showing how money may be spent to greatest advantage in poor homes. Atkinson, in his Science of Nutrition, pp. 11–65, Springfield, Mass., 1892, also discusses the subject quite fully. An attempt is made by both these authorities to state just what proportions of the different nutritive elements a child's dietary should contain at different ages, but the results are nothing more than suggestive, for children differ greatly in their needs. A highly organized, nervous child, working hard

That imperfect nutrition is the cause of much of that emotional estrangement in childhood which is called irritability, ugliness, viciousness, or something of that sort, has been satisfactorily evidenced to the writer as the result of a number of observations which he has been able to make upon young children. The following case is typical of many others: H—— was a well-formed child at birth, and continued to develop normally during her first five months. Throughout this time she slept very well, and for the most part seemed happy and contented. The constant expression on her face showed healthy feeling, and she rarely made a disturbance. At about the fifth month a change seemed to gradually come over her. She did not sleep so well; the expression on her face showed less happiness and contentment, and by the sixth month she could be called an irritable and peevish child. She who had been previously an especially happy child did not now smile often; and the things which ordinarily attract children of that age seemed to be of little moment to her. Some member of the family was now kept busy much of the time endeavoring to soothe her troubled spirit. This state of affairs continued until about the eighth month, when it was decided to make a change in

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in school, requires much more nerve nutrition than one of a phlegmatic temperament who may be leading an easy life at home. Temperament is an important factor in this matter of nutrition. Spencer (*op. cit.*) has some excellent things to say along this line, pp. 214–235.

* *Cf.* Warner, *op. cit.*, p. 81; Krohn, Child-Study Monthly, vol. i, No. 10, p. 565 Holmes, Transactions of the Illinois Society for Child-Study, vol. i, No. 1, p. 205.

the diet. She was given a food rich in materials to nourish the nervous system, and within a week it was observed by all who knew her that there was a marked improvement in her temperament. After two weeks of proper nourishment she had regained her former restfulness, sleeping peacefully a good portion of the time; and gradually the expressions of irritability and moodiness disappeared. Her face would now light up as formerly with pleasant smiles whenever any one she knew was about, and once more she appeared to every one as a very good-feeling, happy child. From that time on care was taken with her food, keeping it rich in albuminous elements, and her intellectual and emotional development was most satisfactory in every way. Some time after her diet was enriched it was learned definitely that the food she had been getting just previously was quite deficient in nutritive elements.

Brain fatigue in childhood, as physicians well know, is sometimes due to pathological conditions wherein the peculiar elements needed to nourish the brain are not assimilated from the food. X—— and Y—— are two children of the same family, who at the ages of five and seven respectively came under the writer's notice. They were then giving their parents a great deal of trouble. They were highly organized, irritable children, with whom no one seemed to get along pleasantly. While at home nothing was permanent in its interest for them, and discipline was a serious problem. When they began going to school matters grew worse. While apparently bright children, they did not make rapid progress, and always seemed utterly fatigued at the close of the day's work. When they reached home at night any little thing which crossed their paths would so greatly annoy them that they were much of the time in tears and passions. After every effort had been made by the parents to discover what was the matter, an analysis of the blood was finally decided upon, and it was found that it lacked the right proportion of elements to properly nourish the nervous system. A special diet was then begun, and other treatment resorted to to supply this deficiency. After seven months of this special care sleep had been largely restored, the tendency toward irritability had decreased, and the children could now remain in school all day without becoming unbalanced thereby. They were in reality quite different children—keener intellectually, and expressing more estimable traits of character.

Lately a group of similar cases has come to the notice of the writer. The members of a family for several generations have been afflicted with anæmia of the brain, and the children show easily all the evidences of cerebral fatigue. One girl of twelve is characterized by willfulness and carelessness, as her teachers say.

She is an irresponsible child, acting upon every impulse without much regard to the outcome of her actions. This lack of inhibition or forethought or considerateness is characteristic of her intellectually as well as temperamentally. One day she may do fair work in school, and the next day fail utterly, being apparently attracted by everything but the work before her. She would pass in most schoolrooms as a stupid, willful pupil. A cousin, a boy of seven, has somewhat the same qualities. He fatigues more readily than other children of his age, and when in this condition he is impulsive, quarrelsome, and even vicious toward his companions. His attention wanders in school, and while bright in some ways, he has little power of continuous application to hard work. He is spoken of by his teachers as a "peculiar" child, a term so extensively used as a cloak for ignorance respecting the causes which make one child different from another.

III.

Imperfect nutrition is not the only source of brain fatigue in childhood. When the energy of the cerebral cells is consumed too rapidly by overwork, worry, or intense excitement of any kind, the same unhappy effect is produced. One would not expect to find any of these brain-fatiguing conditions in the golden age of childhood, since one would think the struggle for existence with its terrific strain in our day might be left until later life, where doubtless it must be encountered by every individual. But while our children may not be troubled by the social and financial problems of daily life, yet in many homes and schools, especially in our cities, they are from the cradle up subjected to continual over-stimulation, which is as inimical to the right development and hygiene of the nervous system as the whirl of society or the crush of business. According to the American fashion in most households, infants of a few months as well as children of maturer years are permitted to be in the presence of the older members of the family much of the time. Guests always expect to see the baby, to hold it, and to stimulate it in all sorts of ways to see how prettily and intelligently it reacts. This practice would not be so objectionable if it were not that when the average adult has a little child in his arms he is always intense and restless in voice and actions. Few people seem to appreciate how such treatment taxes the nervous strength of an infant. But let an older person imagine what a strain it would be to have excited people about him constantly, tossing and patting him, and making all manner of facial and vocal demonstrations for his entertainment. How much more it must wear upon a child to whom these things are new and strange, all arousing the strongest emotions of fear, curiosity, or excitement, and thus draining the plastic, immature brain of its vitalities! In some homes it is quite the custom to allow a little babe to be freely handled by strangers of whom it is afraid; and then we wonder why in later life our children are the victims of a vast brood of fears which sap the energies and curtail the pleasures and usefulness of life in every direction.

It is not alone the trials of meeting strangers that are extremely fatiguing to young children, but the experiences with parents and other members of the family are often as exhausting. The young child, with its fresh, innocent ways, is not infrequently regarded as a plaything for the entertainment of its elders, and so is teased and tormented in all sorts of ways because its response is so novel and interesting. Of course, parents would not call such treatment teasing, but that is precisely what it amounts to from the child's standpoint. Just recently the writer was witness to a scene which is typical of much that may be observed in one's environment if he has an occasion to look for it. A little child disliked very greatly to have anything touch its nose, and would make the liveliest efforts to dispel whatever came in contact therewith. The sweet baby movements were naturally enough very amusing to an adult who did not see anything in them but fun for himself. Frequently some mature person who knew the child's characteristic in this regard would place a finger or other object near the delicate member to see the little one strive with arms, head, and body to drive it away. On one occasion a grown woman, whose years should have taught her better, was seen to tantalize the child for two or three minutes, finally throwing it into a state of fatigue. When it grew restless and began crying it was grabbed up, tossed and thrown about, and talked to in a loud voice. This violent stimulation overcame the child's impulse to cry for the moment, but had the effect to further fatigue it, which was shown later in continual crying until it fell asleep. If one will think of such things going on day after day throughout the early life of a child, the irritable, unbalanced, disagreeable children of one's acquaintance may be accounted for at least in part.

The writer has had opportunity to study with some care the effect which a lady with high-pitched, nervous voice and intense nervous face and manner, but otherwise of most estimable characteristics, had upon a little child, H——. Whenever she was near H—— she insisted upon taking her, and she thought the proper mode of entertainment was to shake and toss and pat her, and to make a great amount of noise and fuss over her. As a consequence, a half hour of such treatment was enough to fatigue H—— for a whole day, and her disposition at such times would be quite changed from a happy, good-natured child to one easily irritated and satisfied with none of her ordinary pleasures. A nervous, irritable parent will breed these qualities in his children, because his personal contact will overstimulate them and they will be in a state of chronic fatigue. Such a parent will be apt to nag his children, to be constantly forbidding or commanding, and this arouses emotions which draw off the energies from the brain very rapidly. Antagonism is a breeder of nerve fatigue, and some children seem hardly ever to be free from it during waking hours.

Again, in many homes older children make the life of the smaller ones wretched much of the time. The writer knows a family where there are three children, the youngest about two years of age. The older ones seem to find no greater pleasure than to tease the babe on every opportunity, for she occasions them much merriment by her violent vocal and bodily expressions whenever she is tormented beyond endurance. One does not need to remain about this home long before seeing plainly that this child is being worried into an ugly disposition. Even at two years she has reached the point where she is intolerable much of the time, showing her unbalanced condition by flying into a passion over every little thing that occasions her displeasure. The attitude of the older children serves to keep her in a more or less constant state of fatigue, and the actions performed in this condition are rapidly forming habits, thus determining her character.

The evil effects of overstimulation are evident also in the attempts of parents and teachers to hasten as rapidly as possible the intellectual development of the children under their care. It has come to be regarded as desirable that a little child should begin hard work in school at five, and keep it up continuously until the college course is completed. Many think it creditable to a child to be precocious in his learning, and so he is encouraged to sit still and study instead of being spontaneously active in play much of the time. He is subjected in school to the great strain of appearing before his elders in "speaking pieces," etc., all of which tends to overstimulate, and hence to fatigue easily and unnecessarily. There is in our midst a feeling that maturity ought to be reached as early as possible and by the shortest cuts, but science shows that excessive rapidity in development is secured at the expense of mental health and attainment of the highest ultimate ends.* It assures us that too early and rapid organization of the nervous system through undue stimulation or educative influence of any kind finally results in arrested growth. Precocity is usually succeeded by mediocrity, if by nothing worse.* It is significant that those races that are most precocious are ultimately the least intelligent and progressive,† more nearly resembling the lower orders of animal life, where the young possess at birth nearly all the powers they ever attain, and so are not educable to any great degree. It is to be feared that overstimulation in numerous ways of children in American homes and schools leads to early cessation of, and hence to an ultimately inferior, physical and mental development.

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* *Cf.* Spencer, *op. cit.*, p. 262.

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THE SCOPE OF BOTANY.

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WE hear much talk nowadays about the new chemistry, the new psychology, the new theology, even the new woman. It is not my purpose to present in this paper any remarks which could be styled "the new botany," for I hope that there is no new botany. Every department of human inquiry should be plastic enough to be modified by increasing knowledge, it should open new fields for investigation, and its members should increase in power. I feel that botany has been plastic, that the science has grown through the years until now it has not merely men who are actively seeking its development, but also those who are seeking for knowledge in ways and by means that have never before been employed, seeking for a knowledge not of facts only—interesting as many of these may be in themselves—but seeking in these facts, painfully and slowly accumulated, the evidences of deeper things, of the great principles which govern the world. The definition is a familiar one—"botany is that science which seeks to answer every reasonable question regarding plants"—and to many people botany is nothing more; but I should not venture to write upon this topic had I nothing more to say than this. The botanist regards his plants not as an end, but as a means of learning a little more about life. The human physiologist was the first to try to penetrate the mystery of life; later the animal physiologist, studying lower forms than man, attacked the same problem; and still later, only within the last hundred years one may say, the vegetable physiologist has come to the aid of the other two. All three, studying the manifestations of life, are seeking to solve the puzzle, What is life itself? With such an aim, the science of botany is more than a pleasant recreation for a summer holiday, it is more than a little accomplishment which can be taught in a finishing school for girls, it is even more than the sentimental or the poetic or the artistic contemplation of the beautiful as displayed in the rose and the lily. The botanist is devoting his time, his energy, his ability (if he has any) to the study of plants not because "it must be so lovely to be always studying flowers," as I have heard so often to my great discomfort, but that he may learn something that will help his fellows in their everyday lives, give them some truer notion of the physical life, and reveal to them some of the principles that underlie it all.

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* *Cf.* Porter. The Physical Basis of Precocity and Dullness. St. Louis, 1893.

† *Cf.* Christopher. Handbook of the Illinois Society for Child-Study, vol. ii, No. 2, pp. 109–114.

This sounds very fine, but how is the botanist doing all this; and what is the evidence that he has even begun to do some of this? The beginning of botany in this country, so far as the white settlers are concerned, was coincident with the first exploring expeditions, when the hardy pioneers made note of the vegetation, whether it was luxuriant or sparse, whether the plants were poisonous, useless, or useful. That even then a better and more general knowledge of the flora was deemed important, is proved by the record that at the college at Newtowne, founded in 1636 and now known as Harvard University, the study of plants was part of the curriculum in every summer term. To learn the names and the striking properties, useful or harmful, of the plants of a new country is the most natural endeavor of those who are to make it their home. From that time until now, it has been the custom to teach in the schools, and in many of the colleges, just these things. Because most of us go no further in our study of plants, we conclude that this must be all. The school boy and girl painfully learn the descriptive nomenclature, as we find it set forth with wonderful clearness in Gray's Text-book of Botany—that leaves are linear or obcordate or punctate with pellucid dots; that stamens are distinct or hypogynous or tetradynamous; and then they find that the bird-foot violet is technically known as *Viola pedata* and the lily of the valley *Convallaria majalis.* But the school boy and girl have thus simply acquired one means of learning more of Nature. Botany is not a science of names, a science overloaded with names though it may be. The individual who destroys a flower by tearing it to pieces (analyzes it, as the ladies say), and finds by the aid of some tiresome artificial key the Latin name of the plant which bears it, has conquered the difficulties of the botanical alphabet; but until he goes further he knows absolutely nothing of the literature of Nature. Children now learn to read before they learn the alphabet, and in many of our better schools the pupils begin to study plants before they learn the descriptive terms applied to them. To have a knowledge merely of the names of plants is to possess a series of jug-handles without the jugs or anything in them. The handles belong with the jugs, and jugs should have, at times at least, something in them. Now, the truly scientific man who seems to be devoting his time to acquiring a knowledge of the names of plants, is in reality learning much more about them. He sees that plants of different sorts resemble one another in greater and less degrees. Those which resemble one another, not merely in superficial characters, which may be due merely to like conditions of growth and life, but in the more fundamental and less obvious characters, he assumes are related; and his studies lead him to formulate a classification which shall indicate in what ways and in what degrees the different plants are related. So we see the first step in the development of botany, the study of plants with a view to arranging them in some classification which shall subserve the convenience of students and at the same time indicate the relationships of plants to one another. But the word relationship implies something more than superficial resemblance. The resemblance is an index of descent. The older botanists — Jussieu, Linnæus, and others like them — believed that plants are now as they were created—created either at the beginning of the world or brought into existence later by separate acts of creation. The more critical observations of later years have shown that no two plants are exactly alike, that the offspring are not the duplicates of the parents, that plants are constantly changing as organisms and as generations of organisms. Certain influences cause certain changes; the different conditions to which plants are exposed in sunny and shaded, in moist and dry, in exposed and sheltered positions—the climatic, the geological, the geographical conditions—all have their effects. And so the study of plants extends from the examination of those just about us to a comparison of these familiar forms with those in other localities. There develops the science of geographical botany, which seeks to penetrate the reasons for the existence of certain plants as characterizing the North American, the central European, the Australian, and other floras.

In order to solve the problems thus encountered, the botanist must know not merely the present geographical and geological conditions of our globe, or of that part of it which he especially studies, but also what its geological history has been. This throws light upon many questions. For example, the North American flora is much richer than that of Europe. We gain some idea as to the reasons for this when we realize that the last ice period made much of Europe and of North America uninhabitable, as well for plants as for animals. All were compelled to migrate to the southward or to perish. The Isthmus of Panama and the broad expanse of Central America offered a refuge for the tender forms which could not withstand the rigors of the Ice Age when North America was covered to the Ohio Valley with a great continental glacier. In the milder climes many of them survived, and as the ice retreated they slowly followed it—how, I shall take occasion to show in a moment. But between the ice-bound continent of Europe and the warmer lands to the southward intervened then as now the broad expanse of the Mediterranean, which could be traversed but by few animals and by still fewer plants. Many forms perished, and their places are empty to this day. Hence we see one reason for the greater number of plant species on our own continent.

The botanical geologist finds other things to study, for there are many plants of bygone ages preserved to this day as fossils in the rocks of various horizons. The science of paleobotany grows more slowly than the science of paleozoölogy, which greedily usurps the name of paleontology, as if plants were not quite as important, had not contributed quite as much of value to the earth's crust, as animals. The reasons why paleobotany is such a slow-growing and fragmentary science are two. In the first place, as I have suggested, paleontologists devote themselves in their investigations and teaching too exclusively to animal remains, and hence he who will know more of the plants of past ages must study and learn largely unaided. But the second reason is more fundamental—namely, that plant structures are less easily preserved than those of animals (whose shells or other hard parts are very resistant), and hence many have been destroyed during the various changes that the rocks in which their remains were imbedded have undergone. The fossil remains which are now known give confirmation of the fact mentioned a moment ago that plants are ever changing. The plants of the Carboniferous Age were very different from those of to-day. The aspect of field and forest then must have been mysterious indeed; the heavy atmosphere, the intense light, the moisture, contributing to a vegetation of more than tropical luxuriance. Between the lofty stems of tree ferns, in the deep shade cast by their great fronds, wandered animals hideous to the eye, though perhaps no more dangerous than our mild-eyed cows. But we find to-day, growing here and there, plants which greatly resemble those of the coal measures, not only the ferns, but the horsetails (scouring rushes of our ancestors, *Equisetum*), the Lycopodiums, without which no northern Christmas festival is quite complete, and others less conspicuous. These the paleontologist convinces us are the direct descendants of those plants which compose our coal. He thereby adds his facts to that history of life which shows that plants are related, that they have common ancestors, that they have developed through the ages until now.

Another field of botanical study is being cultivated by those who devote themselves to the investigation of the adaptations of plants to their surroundings. The adaptations are so many and so perfect that all are tempted (and many yield) to let their sentimental imaginations replace that spirit of critical inquiry without which no scientific work of lasting value can be done. The adaptations for disseminating seed—the winged fruits of our maples, elms, and lindens, for example, or the silken parachutes of the dandelion and the milkweed, the explosive touch-me-not, and the wild crane's-bill with its boomerang—show one how a region devastated by glaciers, fires, or floods can be repopulated. The relations of flowers to the insects which are to pollenate them were first discovered by Christian Conrad Sprengel, and described in a now rare and highly prized book, The Secret of Nature Revealed; but botanists left Sprengel and his secret to themselves. Darwin rediscovered the secret, then discovered the book, and since then the world has been deluged with writings good and bad on this most fascinating subject. The whole field of phytobiology, the adaptations of plants to their surroundings, is open to every one whose interest in Nature takes him into the fields and woods—even into the public parks. No knowledge of technical terms is necessary to enable one to pull apart one of the great horse-chestnut buds, to notice the water-proofing varnish on the outside, the scale armor just within, the soft, downy padding which protects the minute leaves and the tip of the stem from sudden changes of temperature, to see that leaves or flower cluster are already formed in miniature ready to burst their coverings when the favorable time shall come.

The minute internal structure of the plant is as important a subject for investigation as the more evident features of which I have just spoken. The microscopic study of plants leads one to the most fundamental questions in biological science. It was in consequence of the microscopic studies of a botanist that it was discovered that all organisms are composed of cells, that these cells are essentially minute masses of a viscid substance—protoplasm—which is "the physical basis of life." Is it any wonder, then, that men have devoted their lives to its study, seeking through a knowledge of its structure to learn something of the life of which it is the physical, tangible embodiment?

Among plants as among animals there are two modes of reproduction, the sexual and the nonsexual. Higher animals reproduce themselves only sexually. Some of the higher plants reproduce themselves in the wild state nonsexually as well as sexually, as, for example, the blackberry by its runners, the poplar by those saplings which develop from underground parts often quite distant from the parent trunk; and most of the higher plants can be reproduced in cultivation by cuttings, slips, etc. The sexual reproduction has been developed from simple forms in low plants—for example, the seaweeds—to a state of complexity among the flowering plants which is equal to that among the higher animals. Though there are no superficial resemblances between the sexual reproduction of animals and that of plants, yet the processes are intrinsically the same. The differences are mainly superficial, like those in the means of conveying the male elements to the female elements. The male and female elements in plants are very different from one another, just as in animals, much more different from one another than these elements are from the corresponding elements among animals. In the one kingdom as in the other fertilization takes place when a male element fuses with a female element. So much alike indeed are the microscopic processes in the two kingdoms that much light has been and still may be thrown upon the great general questions of the influence of parents on offspring, of heredity, of descent, of development, by the microscopic study of the phenomena of fertilization and development among plants. There is, therefore, a science of embryology cultivated by botanists which is of almost equal value to man with the science of embryology cultivated by zoölogists.

The microscopic study of the purely vegetative as distinguished from the reproductive parts of plants reveals certain mechanical principles of structure which engineers are now just beginning to follow in their buildings, especially those constructed of materials which in large masses resemble in physical qualities those microscopic elements of which plant structures are composed. We see that the stems of our native trees and those of the palms and others of warmer climes are really frames consisting of long, slender, light yet strong and elastic beams so joined together that they form a structure capable of supporting great weights in spite of the force of gravitation, and so buttressed at points of branching and where the aërial structures spring from their strong foundations in the soil that they are able to resist the really tremendous strains brought to bear upon them by high winds. These principles of buttressing, of accurate balancing, of avoiding sharp angles by the substitution of curves, of a light, elastic framework of great strength, which are common to all the larger plants, we see employed in those buildings which by reason of height, position, or purpose are exposed to great strains. For example, there is more than a fancied resemblance between the Eiffel Tower and the steel lighthouses of our coasts to the buttressed, spreading bases of our elms.

The study of structure, whether macroscopic or microscopic, leads one naturally to investigate the functions of the parts. The study of functions is physiology, and since we have given up the older notions as to the sacredness, the supernaturalness, of the phenomena of life in favor of the more rational view that they are chemical and physical, all physiologists to-day are pressing forward, with chemistry and physics as their allies, to larger knowledge and clearer ideas as to what constitutes life. Far as we still are from a solution of the riddle of the ages, yet during the present century progress hitherto unequaled has been made. Animal and vegetable physiologists are now going hand in hand toward their common goal. In studying the processes of nutrition, growth, reproduction, and the phenomena of perception, reaction, and exhaustion, they are supplementing one another. There are indeed some few physiologists of training and disposition so broad that they decline to be known as animal or as vegetable physiologists, but wish to be called what they really are, students of the functions of living organisms and seekers after light from whatever source upon life itself. The more one studies the physiology of animals and plants the more one sees that the distinctions which have been made between the two are more apparent than real, and that as in so many other cases our names are for convenience rather than for the exact expression of the truth.

The physiologist finds that there are two great classes of plants: (1) Those which, able to obtain from the crude materials of the soil and the air all the elements which they need for their nutrition, lead self-dependent existences; and (2) those which, unable to elaborate their food from such matters, must get it from other organisms, either directly or indirectly. All animals depend ultimately for their food upon those plants which are able to elaborate living matter from lifeless mineral salts, water, and air. But there are quite as many plants which are as dependent as animals. The groups of parasites, the flowering and the flowerless, the dodders and many of the fungi and bacteria, for example, are absolutely dependent upon living organisms, either animal or vegetable as the case may be, for their food. Other plants extract from the dead and more or less decayed remains of organisms the highly elaborated nitrogenous and carbon compounds which are essential to all life. Still others are fairly independent, but supplement their self-made food by other means; for example, the whole group of insectivorous plants and several of the orchids. The saprophytic plants, those living on dead organic matter, are very important in the economy of Nature. They accomplish rapidly, and with much less damage or offense to other organisms, the decomposition of otherwise waste matters which could be removed, but slowly by the processes of chemical non-vital oxidation. Even the parasites are not wholly evils, for some of these man has already tamed and compelled to perform some of the most important domestic operations—the raising of bread and the making of cheese and vinegar. Alcohol is one product of the activity of yeasts, and to these we owe our wines and beers. The precision in the manufacture and the uniform quality of the product of bread, cheese, vinegar, and beer have come only within recent decades when the microscopic organisms upon which these processes depend have become known and regularly raised like wheat and cattle. Recent investigations plainly suggest that greater precision and more uniform success can be obtained in the production of wines and in the curing of tobaccos. Doubtless we have but begun to domesticate the plant parasites which can be made useful to man, and more extended investigations will probably show that many processes in the domestic and other arts which are now tardy and uncertain can be carried on rapidly and accurately.

The science of bacteriology has now become so specially developed along medical lines that in this aspect it can scarcely be counted longer a part of botany; but we should not forget that the first knowledge of the bacteria came through botanists, and that the methods now employed in studying and combating them were first suggested by botanists, and every teacher of botany should regard it both a duty and a privilege to spread among his pupils and the public in general such a knowledge of the habits and effects of these minute organisms that public sentiment will demand not only personal but municipal cleanliness. An adequate supply of water, free from contamination at its sources and in its passage to our houses, contributes not only to the comfort, but greatly also to the health, of any community. The installation of a system of sewerage, for the safe disposal of the extremely dangerous waste matters of houses and stables, will come as soon as public sentiment is enlightened as to the probability of fatal disease resulting from the infection of drinking water, milk, and other uncooked foods from such decaying matters. It is now known that street dust contains millions of organisms which, when they find lodgment in human bodies, made suitable by weakness for their growth, cause the most malignant maladies. Even the dust of our rooms contains numberless organisms of these same sorts. So it behooves us as intelligent people to strive to bring about such cleanliness of streets and houses that these dangers will be reduced to a minimum.

The bacterial and fungous diseases of other animals than man, and the diseases of plants, are still being studied by botanists. We have only begun to know the dangers which menace the farmers' crops and stock. To study these dangers, to devise means to avoid them, to discover cures for those plants which are attacked by disease, are the tasks which the vegetable pathologist has before him.

Agriculture and horticulture are simply the practical applications of principles defined by the study of vegetable physiology. Questions as to the suitability of certain soils for certain crops are answered by the practical farmer, who scorns the aid which the scientific man might give him, by such expensive experiments as sowing the area in question with the seeds of the crop which he hopes to reap. If the crop is a good one, the farmer rejoices; if he gets but a trifling return for his season's labor, he grumbles at his luck, or wants the Government to order a bounty, or to pass a prohibitory tariff. The market-gardener should know now as the result of the published investigations of vegetable physiologists at agricultural experiment stations, that some of the vegetables and fruits which bring the highest prices when marketed out of season can be brought to perfection much earlier when grown not only in sunlight by day, but under the electric light by night. Lettuce, for example, can be marketed about two weeks sooner after planting if illuminated day and night.

The horticulturist daily proves by producing various and often striking varieties of flowers or fruits the falsity of the old notions as to the fixity of living organisms. I must confess that it seems to me rather disrespectful, some persons might say rather impious, so to tamper with the natural or "divinely appointed" forms of plants, as to produce the monstrous chrysanthemums which we may see in exhibitions or in private houses. But these exaggerated and often extremely ugly because so artificial forms are the strongest evidences that the organic world, of which we are a part, is extremely plastic still in spite of its age; and that those factors which have accomplished the evolution of present complexity from primitive simplicity are still operative, and that man as well as other organisms has not yet reached his final and highest development.

I wish to say one word of that aspect of botanical science which is still but little regarded in our country, but which, if our successors are to have any forests, must receive due and practical notice. I mean the science of forestry. In Germany especially, but in other European countries also, there are forestry schools, where young men receive that scientific and many-sided training which will fit them properly to administer the private and Government wooded lands. It is an interesting fact that, great as is the expense in maintaining these schools and in managing the forests, yet the forests of Germany are one of the most profitable properties of the Government. The railroads pay a trifling interest still, but the forests yield regular and, for Europe, high interest. We must soon acquire, by purchase or otherwise, such control of our still forested areas as will insure their preservation and intelligent use, else the boastful prophecy which I have heard more than once in Germany will come true, that Germany will be exporting wood to America within fifty years! The Forestry Division of the United States Department of Agriculture, and the small forestry associations scattered here and there in the *cities*, precisely where there can be no forests, are doing all they can to arouse public interest in the matter, and to prevent further reckless deforestizing. But to leave the trees unfelled is not all; to replant where replanting is still possible, to fell the trees that are now of useful size, to thin out that others may attain better proportions, to protect against fires, these are equally important. To do all this well demands intelligence, knowledge, and training. The training of the skilled forester must be largely botanical; for though he must know enough about zoölogy to be able to distinguish and to combat insect and other animal pests, yet he must know the principles of vegetable physiology and pathology. For these he must study under some thoroughly trained botanist.

I have attempted to sketch, I fear in very impressionistic fashion, the scope of a science whose value to man is great and personal, which is many-sided, and which is worthy of the devotion and activity of those to whom it is an absorbing interest.

ALCHEMY REDIVIVUS.

By ALEXANDER E. OUTERBRIDGE, Jr.

BASIL-VALENTINE, a famous alchemist of the middle ages, was the most noted exponent of the belief in the transmutation of metals. He thought that the germ of the precious metal gold was hidden in the base metal antimony, and claimed that by following certain mystic formulas the gold could be recovered. About the year 1445 he published in the Latin tongue a celebrated treatise entitled The Triumphal Car of Antimony, which had a great reputation, not only among his contemporaries but among his successors. The treatise was couched in cabalistic phraseology—a sort of abracadabra—which, of course, the vulgar people could not comprehend; it was designed only for his disciples. The book purports to contain the "twelve keys of the great stone of the ancient philosophers."

His formula for converting antimony into gold is interesting at the present time, in view of the fact that a modern alchemist has actually succeeded in inducing the Secretary of the Treasury to officially order an investigation, by three of the mint experts, of a process of transmutation, or "creation," of gold which is singularly similar to the old alchemists' plan.

Basil-Valentine concealed his secret from the common people in the following mystic words: "The king's diadem is made of pure gold, and a chaste bride must be married unto him, wherefore, if ye will work on our bodies take the most ravenous gray wolf, which, by reason of his name, is subject to valorous Mars, but by the genesis of his nativity he is subject to old Saturn; found in mountains and in valleys of the world; he is very hungry; cast into him the king's body that he may be nourished by it; when he hath devoured the king make a great fire, into which cast the wolf that he be quite burned, then will the king be at liberty. When ye have done this thrice, then hath the king overcome the wolf, neither can he find any more of him to feed upon."

The mysterious language adopted by the alchemists was not always owing to an intention to deceive; many of these fanatics believed that it was wicked to reveal the hidden secrets of Nature to the common people, and might even cause the death of the author. Thus, Wilhelm von Schroeder, in 1684, wrote a book entitled Necessary Instructions in the Art of Gold Making, in which he says: "When philosophers speak openly, a deceit lies behind their words; while when they speak enigmatically, they may be depended upon."

Reverting to the enigmatical formula of Basil-Valentine, it is said that the key to this mysterious jargon gives the following simple explanation: The ravenous gray wolf is the sulphuret of antimony. The king's body typifies the metal gold. The sulphuret of antimony is decomposed by iron by the aid of heat, and is thus "subject to valorous Mars." When these elements (antimony, sulphur, and iron) are subjected to a great fire in a crucible, the king (gold) imprisoned in the wolf (antimony) is liberated.*

The modern process which the three mint experts were called upon to investigate, and upon which they have reported negatively, was at first shrouded in secrecy; but the inventor himself has recently given to the public his formula, in a newspaper interview, which one of the experts stated at a meeting of the Franklin Institute is substantially correct. His process consists essentially in subjecting antimony, sulphur, and iron to intense heat in a crucible, whereby a portion of the antimony is supposed to be changed or transmuted into gold, and this is subsequently recovered by the usual metallurgical methods.

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* In 1423 Henry VI of England issued a royal proclamation encouraging the art of gold making, and in 1476 Edward IV accorded to a company "a four years' privilege of making gold from quicksilver." The Danish ducats of 1647 were made of gold obtained, as it was believed, from artificial sources, by Caspar Harbach, the alchemist of Christian IV. In 1648 a large medal was struck for Emperor Ferdinand II from "artificially prepared gold," and the ducats struck under Landgrave Ernest Lewis, of Hesse-Darmstadt, were supposed to be of artificial gold prepared by the transmutation of lead. In 1700 an alchemical work appeared bearing the appropriate title Chymical Moonshine.

The experts found, on repeating these experiments, using the purest antimony that could be obtained from chemists, that a tiny globule of gold and silver remained after removing all the iron, antimony, and sulphur; but they also found that traces of gold and silver are invariably associated with native antimony, and when they succeeded in producing chemically pure antimony for the test, not a trace of gold or of silver resulted from the subsequent transmuting or "creative" process.

Some criticism has been expressed that the United States Government should have dignified this ridiculous claim, to the extent of ordering an investigation of it by the mint metallurgists, but their report is well calculated to set at rest the preposterous scheme which had already attracted not a few gullible people, including some investors.*

This investigation recalls a series of interesting experiments which were made in the Philadelphia Mint about forty years ago by the former assayer, the late Jacob R. Eckfeldt, the results of which were communicated to the American Philosophical Society by his assistant and successor, the late William E. Dubois, who also aided in the work. Samples of nearly all the known metals were obtained from various parts of the country; these were subjected to the usual processes for detecting the presence of gold, the greatest care being used to avoid errors. Gold was found in all the specimens of antimony, bismuth, lead, copper, etc., varying from one part in four hundred and forty thousand parts in a specimen of antimony to one part in six million two hundred and twenty thousand parts in a specimen of galena from Bucks County, Pennsylvania: this was equivalent to two grains and a quarter, not quite ten cents, to the ton.

The most remarkable result of all was obtained from specimens of clay from various localities within the limits of the city of Philadelphia; the clay was taken from a depth of about fourteen feet below the surface, and was found to contain gold in the proportion of one part in one million two hundred and twenty-four thousand parts of thoroughly dried clay, and was very uniformly distributed.

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* It is stated that the inventor of the so-called "gold creative process" applied for a United States patent, and, upon its refusal, the matter was brought before the present Secretary of the Treasury, who ordered the investigation to be made in the metallurgical laboratory of the Mint Bureau. The committee appointed by the Director of the Mint, in accordance with these instructions, consisted of the assayer of the Mint Bureau, the superintendent of the assay office in New York, and the melter and refiner of the Mint in Philadelphia. They adhered closely to the inventor's formulas. An abstract of their report has appeared in print.

The report says: "In order to calculate, with some accuracy, the value of this body of wealth, we cut out blocks of the clay, and found, on an average, a cubic foot, as it lies in the ground, weighs one hundred and twenty pounds as near as may be. The assay gives seven-tenths grain, say three cents' worth, to the cubic foot. Assuming the data already given, we get four thousand one hundred and eighty million cubic feet of clay under our streets and houses, in which securely lies one hundred and twenty-six million dollars. And if, as is pretty certain, the corporate limits of the city would afford eight times this bulk of clay, we have more gold than has yet been brought, according to the statistics, from California and Australia."

Other calculations show that every time a load of clay is hauled out of a cellar enough gold goes with it to pay for the carting; and if the bricks which front our houses could have brought to their surface, in the form of gold leaf, the amount of gold which they contain, we should have a glittering show of two square inches on each brick. A single specimen of zinc proved to be absolutely free from gold.

These investigations proved that, while gold is justly considered one of the rarest metals, it is also one of the most widely diffused, and there are many philosophical reasons to be found in explanation of this apparent paradox.

THE FORCES IN AN AIR BUBBLE.

By M. G. VAN DER MENSBRUGGHE.*

IN 1880 I had the honor of lecturing before the Class of Science on the metamorphoses undergone by a drop of water, when I described the several phases of the grand cycle which the drop passes through from the moment it forms part of the great ocean mass till the time when after long journeys and numerous transformations it again joins its companions in the sea. A few months ago I in a similar way told the history of a grain of dust, dwelling especially on the universality and abundance of solid particles in the atmosphere, pervading everywhere on the surface of the earth.

I now proceed to describe the career of another minute body hundreds of times lighter than a drop of water or a solid corpuscle, confining myself to the consideration of its relations with liquids and solids, and we shall find that it in no wise falls behind its rivals in activity and prowess. This marvelous little being is a simple particle of air.

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* Address before a public meeting of the Belgian Academy of Sciences, December 14, 1895.

Although this particle and its companions wholly escape our vision, they are diffused everywhere around us, and even penetrate our organism to such an extent that without a multitude of them playing a definite part within our body we could not breathe or live for an instant. We can not isolate these particles of air, and could not see them if we did, but we can isolate masses of them by various methods and distinguish them very clearly. Thus let us take a watch glass and a capsule of water, and turning the concavity of the watch glass down, incline it slightly and plunge it into the liquid. Immediately we see a bright line that appears to define the limit of the moistened part of the concave surface of the watch glass. The rest of this face of the glass is kept from being wetted like the whole of the convex surface by the intervention of a mass of particles of air, which, somewhat compressed during the immersion, group themselves into a gaseous globule. Before it was isolated by our maneuver the globule had constituted part of one of the thousands of concentric layers of our atmosphere, each of which weighing upon the one beneath it and communicating to it besides the weight of the layers above it, they all together determine a total even pressure at the level of the sea of fifteen pounds to the square inch. Our globule of air is likewise subject to this pressure, which is transmitted through the water, and added to it is the weight of the liquid that lies above it.

This globule really betrays its presence only by the bright liquid layer around it. When we inquire for the force by which the regular shape of the globule is controlled, we find it, according to the researches of Plateau, in a thin liquid portion surrounding the volume of air, which is not more than one twenty thousandth of a millimetre thick, and which is endowed with a contractile force always impelling it to occupy the least possible space on the body it covers; and by virtue of its curvature it exercises upon the air imprisoned by the liquid a pressure greater in proportion as the globule is smaller. If these dimensions are extremely small, the gaseous globules are always spherical—as, for instance, the bubbles of carbonic acid that rise through a frothy liquor.

Our globule of air imprisoned in the watch glass, acted upon by the pressure of the atmosphere and by that of the liquid above it, and further by the capillary pressure of the bright film encompassing it, possesses, to resist these three pressures, an elastic or repulsive force which is more marked as it is more closely compressed, and by virtue of which the globule occupies a larger space the instant the external pressure is removed or diminished. Perfect quiet seems to rule in the film enveloping our particles, but this calm is only relative; and if we supposed the ultimate particles immensely magnified, we should find the conditions very stormy indeed. We have already mentioned the elastic force within the globule which gives it a tendency to expand. The liquid enveloping it is also subject to a law which is illustrated when wet objects dry, and when a cup of water placed on the scale of a balance is found to be losing weight from day to day. The superficial particles of water have a constant tendency to separate from the rest of the mass and go off as invisible particles of vapor so light that they rise in the ambient atmosphere. This passage from the liquid to the vaporous condition goes on gradually, so that the distance between the molecules becomes greater the nearer we approach the free surface. While this takes place in the radial direction, the movement gives rise in the tangential direction to contractile forces that act to give the liquid surface the smallest possible extent.

We may now suppose ourselves witnessing a struggle between rival particles, some of which are continually trying to escape into the globule of air, while others—our gaseous particles—are all the time striving to penetrate into the water. The spherules escaping into the air have at the same time an extremely pronounced tendency to resolve themselves into molecules incomparably more tenuous still, and to produce vapor even lighter than the air. As water is a medium of perfect mobility, each detached spherule gives rise to vibratory movements, and these are communicated to the whole liquid mass. If we turn our attention to the particles of air, we find them making incessant efforts to lodge themselves in the open parts of the line of battle. As soon as one of them has penetrated between two liquid molecules in vibration, these, obedient to their mutual attraction, make it advance still further; and so on till it reaches the midst of the mass. Thus many particles of air one after another penetrate to the deepest parts of the water, where they are strongly compressed and acquire greater cohesion, while the mean cohesion of the water continues to diminish; and as the particles of vapor passing into the air finally saturate it, so no more particles of air can go into the water after it is saturated with gas.

It follows that the lower the temperature, and, consequently, the stronger the cohesion of the water, the more considerable may be the quantity of dissolved air; and for this reason, doubtless, the slightest variation of temperature modifies the power of water to absorb air. We can also easily comprehend that the quantity of air dissolved in water increases as the external pressure becomes greater. Numerous applications are made of this property—

in the manufacture of carbonic-acid waters, for instance. The air thus incorporated in the water is easily removed by warming the liquid, when infinite numbers of little bubbles may be seen adhering to the walls of the vessel or rising through the midst of the water. But to drive out all the dissolved air, the water should be subjected to a prolonged boiling, and this causes a wonderful increase in its cohesion after it is cooled; and water which has been treated thus will not boil except at temperatures considerably higher than the normal boiling point. Every engineer knows that the water from which he generates steam in his boilers must be aërated, if he would have the machine work regularly and avoid the danger of explosion.

Seeing so much effort displayed without relaxation on the confines of the water and the air in a simple gaseous globule, it is natural to inquire into the enormous sum of work that must be effected without interruption in the surface common to the whole atmosphere and all the rivers, streams, lakes, and seas of the globe; but the most brilliant imagination is confounded in the face of so prodigious an activity.

Who, indeed, shall measure the immense quantity of invisible vapor diffused in the atmosphere? In what balance shall we calculate the weight of the fogs and the clouds suspended above our heads? Who shall weigh the long streams of ice particles floating in the upper regions of the air? Who, in particular, shall adequately estimate the services that are rendered to mankind by those legions of liquid particles that are carried up to great heights in the atmosphere, and distribute warmth and fertility everywhere?

To return to our particles of air penetrating the free surface of the water, what should we see if we fancied everything sufficiently magnified? Gaseous particles gliding one behind another in the intervals of the upper liquid layer; here, particles of the pre-eminently vivifying gas, oxygen, whose mission it is to purify the water and give breath to the inhabitants of rivers and seas; there, molecules of another gas, the mission of which, among other things, is to modify the intensity of the action of its companion; argon, the office of which we hope to find out some day; and molecules of a fourth gas, carbonic acid, which is essential to the growth of plants. But this is not all, for we are further astonished to see penetrate the water infinite numbers of animal and vegetable germs only awaiting favorable conditions to grow and develop with wonderful rapidity. We all know that if water previously boiled be exposed to the light in an open vessel there will form on the sides of the vessel in the course of a week spots in which a powerful microscope will reveal the presence of millions of minute plants associated with legions of animalcules.

The results of numerous and delicate observations show also that germs of plants and animals exist as universally in the air as in water; and when favorable conditions of light and temperature come, these germs at once grow, multiply, and become visible under the microscope.

Approaching the relations of our air particles with solids, we meet the question of what these minute bodies can have in common with compact masses of invariable form, incomparably denser than they, and all the particles of which seem to be too dense to permit the access of our gaseous particles. This, the hitherto prevalent idea of the structure of solid bodies, does not conform to the real condition; for, just as the superficial parts of liquids tend to diffusion in the ambient air, a like habit exists in the molecules of solids of being repelled from the interior toward the exterior, and they separate from one another, but only in an extremely thin exterior layer. Thus camphor, iodine, ice, and some other substances change into vapor at ordinary temperatures; and the exhalation of perfumes may be something of the sort.

Many other facts point to an exceptional constitution of the free surface of solid bodies, of which I need cite only the experiments of M. De Marçay on the vaporization of metals in vacuum at temperatures below their melting points, and especially the researches of M. Spring on the direct uniting of metals, either of the same or of different species. We conclude from all these evidences that there exists on the surface of solid bodies an extremely thin layer, the density of which diminishes the more nearly we approach the free surface. Let us assume, consequently, such a special constitution for the superficial layer of solids, and, by a new effort of our imagination, witness the unrelaxing work of our particles of air in the immediate vicinity of some solid body; we might thus see them dashing into the invisible intervals between the extreme molecules of the solid and opening passages for themselves through innumerable spaces, whence there results a whole formed of solid particles and more or less condensed aggregations of certain gases. Possibly this is the way in which has been developed that texture, doubtless very fine but still very resisting, which covers all solid bodies and is also very difficult to take away from them.

You ask, Of what interest to us is this incessant activity of the air? We answer that it has an interest of the very highest importance; for without this protecting layer covering solids, every object brought in contact with another would risk adhering to it so closely that they could not be separated without a great effort. It is this invisible layer that permits the workman to use his tools handily, the reader to turn the leaves of his book with ease, the writer to guide his pen at will, and the pedestrian to raise his feet from the ground; in fact, I should never get to an end if I should have to recall the principal examples of the utility of this microscopic cushion of air on the surface of solid bodies.

Long and patient observations by Moser and Waidele have made it extremely probable that every substance has its special gaseous envelope, which depends on the condition of the free surface, the temperature, the pressure, the vapors diffused in the surrounding space, etc. This is so true that it is enough to pass the finger over a plate of glass or metal to modify the minute molecular aggregate covering the surface. We can prove this by tracing, with the finger or any kind of rod or stick, invisible characters on the plate and breathing upon it, when all the tracings will immediately come out on it; for this reason, beyond a doubt, that the vapor of the breath deposits itself in different manners on the surface that has not been touched and on the parts followed by the tracings. Further, if we allow two metallic plates to remain for a considerable time slightly removed from one another, one of which is highly polished, and the other bears engraved characters such as may be found on a presentation watch, on separating them, say after two months, simply breathing on the surface of the smooth plate will cause the characters engraved upon the other to appear revealed. The cause of this appearance is, that the hollowed parts of one of the plates condense more air and moisture, and thus, by frequent changes of temperature and pressure, the parts of the smooth surface opposite the cavities are covered with a gaseous envelope different from that of the parts adjoining, and the difference is marked by a special condensation of the vapor of the breath.

Legions of grains of dust are known to be floating in the atmosphere, not near the ground alone, but miles above the sea level. We may form an estimate of the prodigious number of these solid particles suspended in the air by collecting snow during the earlier moments of a fall; the water resulting from the melting of it is nearly black with the corpuscles of every kind which the little ice crystals have brought down in the cavities of the snow. Later collections of snowflakes give clearer and clearer water. The snow has therefore been called the "broom of the atmosphere." The particles can not be held up in the atmosphere of themselves; for, taken one at a time and thoroughly dried, they will certainly weigh more than the air they displace. To learn the real cause of the phenomenon, we must recollect that the constitution of a solid particle is that of a minute kernel surrounded by a very thin layer of gradually decreasing density, into which the surrounding air infiltrates itself so as to make a kind of sponge; hence, the smaller the kernel the more notable the influence of the lighter sponge. Another perhaps more important cause may be found in the power of the cavities of a grain of dust to attract moisture from the air, by virtue of which an atmosphere of invisible vapor is gathered around the corpuscle so as to form a single system with it. The density of vapor being only about two thirds that of air at the same pressure, this vaporous envelope has great sustaining power, and its presence furnishes an adequate explanation of the suspension of so much solid matter.

Although the presence of these millions of particles may diminish the transparency of the atmosphere, they contribute to the illuminating power of the sun by reflecting its rays in every direction and causing all the space to be pervaded with light, and, intercepting the rays of heat as they pass from the earth, they prevent loss by too rapid radiation. A similar explanation accounts for the suspension of globules of water in clouds.

We come now to the powers of our particle of air to emit sounds, which are always curious and often imposing: manifested in the snap of the coachman's whiplash, when the particles suddenly thrown out of equilibrium execute sonorous vibrations in recovering it; in the resonance of artillery discharges, the roaring of the tempest, the moaning of the surf, and the rolling of the thunder—all reactions of air against forces which have compressed it.

When we bear in mind the power displayed by particles of air hurled in violent wind against a fixed obstacle, we are led to ask how these particles exhibit their energy when the air is traversed by a projectile—spherical it may be—moving with great velocity? Since the air, in spite of its extreme mobility, opposes a degree of resistance to any sudden displacement, the vacuum created behind the projectile is not instantly filled; and not all the particles in front of it being able to get out of the way as fast as it goes along, an accumulation takes place there which exerts considerable pressure against it. The situation then becomes the same as if there was a spring in front of the ball strong enough to nullify every instant a part of its velocity and to deform a solid obstacle placed in its course. Melsen was struck by this thought, and instituted a series of experiments that gained him great credit, the result of which was to prove that the air accumulated in front of a ball flying with sufficient velocity forms a gaseous layer capable of opposing the immediate contact of the projectile with a resisting medium, particularly at the point squarely opposed to the course of the missile. This view was very clearly confirmed by Prof. E. Mach, of the University of Prague, who obtained a photographic image of a projectile moving with great velocity and preceded by condensed gaseous waves. We can not, therefore, doubt that the cushion of greatly compressed air in front of the projectile causes considerable delay in its progress, and consequently a great heating of the ball. We know that this takes place with aëroliths which become incandescent and burst in flying through our atmosphere.

Melsen's experiments led me to suppose (in 1874) that the obstruction and heating of a projectile passing through the air might be notably diminished by driving a narrow and slightly conical channel through the ball and slipping into it a metallic obturator to fit it. "In this way," I said, in my lectures on thermodynamics, "the ball might be discharged without letting more gas escape than usual; once out of the chamber, it would condense the air in front of it, while the air behind it would be extremely rarefied. A difference of pressure would immediately be produced sufficient to force the conical tampon out of the projectile, and after that there would be no more projectile-air pressure." Under these conditions, I said, the velocity of projectiles could be kept up for much greater distances, and the heating would be considerably less. I was not so situated that I could verify these views by experiment; but the principle was applied about two years ago in Germany, in the Hebler Kruka ball, the axis of which is pierced with a small cylindrical channel, enlarged behind so as to be funnel-shaped, and closed with a small plug—the very device I had imagined twenty years before—which, when fired from a cannon, behaved just as I supposed my perforated ball would do.—*Translated for the Popular Science Monthly from Ciel et Terre.*

THE DISCOVERY OF THE SUN SPOTS.

By M. A. LANCASTER.

SPOTS or groups of spots were seen more or less distinctly upon the sun previous to the invention of the telescope. The observations are described under various forms, first among which may be mentioned obfuscations or obscurations of the sun. At other times they were believed to be passages of Mercury in front of the sun, as in 807, a date mentioned by the historians of Charlemagne, and on the 28th of May, 1607, when even Kepler was deceived. In 859 Alkindi thought he observed a transit of Venus; but the black object he saw on the sun's disk was only a spot large enough to be perceived by the naked eye.

Observations of obscurities or spots on the sun have been made in China at different epochs, the most ancient one dating from the year 301. Between that date and the beginning of the thirteenth century the great Encyclopædia of Matouan-lin contains forty-five mentions of the phenomenon. The existence of dark spots on the sun was recognized very anciently by the aborigines of Peru. The Arabs have recorded prolonged observations of the disk of the sun, among which are those of 535 and 626.

The oldest mention of a sun spot in Europe, a spot which was supposed to be Mercury, is by an anonymous chronicler of the eighth century. Different observations of sun spots before the invention of the telescope are recorded in Zach's *Monatliche Correspondenz*, vol. xv, 1807, and in Humboldt's Cosmos, vol. iii.

The new instrument, invented in Holland, first permitted the scientific study of the solar surface. Galileo appears to have seen the spots on the sun for the first time in October, 1610, but did not account for the nature of the phenomenon. Jean Fabricius may have remarked the spots toward the end of the year 1610, and certainly observed them in March, 1611. Scheiner reported his discovery of the spots in April, 1611, but did not account for what he saw. Harriott, who is believed by Zach to have seen the spots as early as December, 1610, and whose manuscripts have been examined by Rigaud, did not really see them till early in December, 1611, and comes, consequently, only fourth in the order of priority.*

There have been lively controversies at different times concerning the claims of these three astronomers to priority in the discovery of the sun spots. The discussions were summarized by Arago in an article published in *l'Annuaire du Bureau des Longitudes* in 1842. The question has been settled by deciding that Galileo first saw the spots with the aid of the telescope, but that Fabricius first announced their existence to the scientific world and pointed out their nature. The texts were plain enough on this point, and the discussion was prolonged more by the agitation of questions concerning the meaning of words than by any need of clearing up the facts.

A work recently published by Dr. Gerhard Berthold on Fabricius † contains a number of previously unpublished documents, and throws light on some obscure points in the history of astronomy at the beginning of the seventeenth century.

An interesting analysis of this essay has been published by M. E. Millosevich in the *Atti* of the Accademia dei Lincei of Rome. While its main object is to establish the claim of Jean Fabricius to priority in the discovery of the sun spots, it further furnishes many facts previously unknown in the life of this astronomer and of his father, David Fabricius. The claim of priority having been already settled by Humboldt, the secondary object is really the more important one. A little-known paper of Jean Fabricius on sun spots and their apparent turning with the sun, published at Wittenberg in 1611, is reproduced in the book; and after it a wholly unknown astrological paper by David Fabricius on the appearance of the new star in Ophiucus, which Kepler's pupil, Jean Brunowski, discovered on the 10th of December, 1604. David Fabricius saw this star for the first time December 13, 1604, or only three days after Brunowski, of whose discovery he certainly knew nothing, and wrote two other notices of it, which are lost. The frontispiece of David Fabricius's *Prognosticon astronomicum* is also given, with a complete list of the author's writings, including those which are lost. Of these, the *Prognostica* for 1607 and 1616 have recently been found at Darmstadt and Nuremberg. From a few facts concerning the life of David Fabricius gleaned from the *Prognosticon* for 1617, it appears that he was born at Essen, in East Friesland, March 9, 1564, and died—killed with a spade by a peasant of his commune—May 7, 1617. He assumed the ecclesiastical dress at an early age, and performed the offices of a court pastor, while he also devoted himself to astronomical studies, and was the first to announce that Omicron or Mira Ceti, was a variable star.* He made this discovery August 13, 1596, and on the same day remarked a star of the third magnitude, red like Mars, and situated in 25° 47′ and 15° 45′ south of the ecliptic. Twelve years passed without his seeing it only very indistinctly, and he did not find it again clearly till 1609. The author observes that the astrological intimations of David Fabricius did not prevent his being a good astronomer of the second rank, like Longomontanus, Scheiner, and Simon Marius. His correspondence with Kepler proves that he furnished him with important material for the composition of his works.

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* These facts and dates are from Houzeau's Vade-mecum of Astronomy.

† Der Magister Johann Fabricius und die Sonnenflecken.

Jean Fabricius, the eldest of seven sons, was born at Resterhave, near Dornum, in East Friesland, January 18, 1587. The *Calendarium historicum* of David Fabricius gives some facts concerning his life. He attended the university at Helmstadt as a medical student in 1605, at Wittenberg in the next year, whence he passed to Leyden, where he was registered as a student of medicine in 1609. Omitting certain statements concerning his astrological and meteorological studies, we remark that the publication of the work to which he owes his fame in astronomy dates from the time of his doctorate in philosophy at Wittenberg, whither he returned after his sojourn at Leyden. The telescope was discovered in Holland in 1608 by the optician Jean Lippersheim, of Middelbourg, who immediately applied to the States General for a patent. Jean Fabricius learned of the discovery at Leyden, and took the instrument to Osteel, where his father was, and with it found the sun spots. Nothing is known of him after the publication of the book on the sun spots already mentioned (1611), except that he practiced medicine at Marienhave, near Osteel, and died there probably about 1617. If the *Prognosticon* for 1618 had not been lost, we should doubtless have had some details respecting his death. In the lack of other sources of knowledge, there is left us the eulogy addressed by Kepler to David Fabricius: "But also reading in your *Prognosticon* for the year 1618, by which I am better informed concerning his [Jean's] too early death," etc.; and further on, "But, indeed, there is this excellent little book concerning the solar spots in the year 1611," etc. The author gives particulars concerning the first day of the discovery, the method of observation by projection, and the conclusions which Jean, aided by his father's advice, drew (*spots fixed in the body of the sun*) concerning the sun's rotation around an axis. Neither the Narration nor the writings of David, so far as they are known to us, give any hints concerning the exact date of the discovery, so that we were confined to guesses till M. Berthold found the *Prognosticon* of David for 1615, which gave the 27th of February (9th of March N. S.), 1611, as the exact date of the event. Furthermore, a letter from David to Maestlin says that the Narration appeared at the time of the autumn fair of 1611, and this is confirmed by Kepler.

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* The period of the variability of this star was determined by Jean Holward, forty-two years afterward.

At this point in his learned essay Dr. Berthold discusses the question of priority, for which a claim was earnestly pressed as against Galileo by the Jesuit Scheiner, who assumed the name of Apelles. It is really very singular, as it appears to the author, that not a word was said of Jean Fabricius in this controversy, and it might be inferred that both contestants alike knew nothing of the Narration, but for certain considerations and facts adduced by Dr. Berthold which make this supposition exceedingly improbable, if not impossible.

It is proper to observe here that after the telescope was invented all the discoveries in celestial objects became, as it were, matters of course, and that, whatever noise might be made about them at first, the merit of the observers is insignificant in comparison with that of the calculators who knew how to reason out the basis of the true system. Even if it should be proved that Galileo learned of the existence of the spots from Fabricius's Narration, or from the letters of the false Apelles, the remarkable fact remains that in his first reply to Welser he corrects the errors in the reasoning of Apelles concerning the direction of the sun's rotation.

In Mario Welser's first letter to Galileo, dated January 6, 1612, he asks Galileo's opinion concerning the spots discovered by Scheiner, and forwards three of the latter's famous letters. Three months afterward (May 4, 1612) Galileo answers him in a very long letter, saying that he has been observing the spots for eighteen months, that he has shown them to several friends, and has besides within a year exhibited them to many prelates and lords at Rome. According to this, he must have seen the spots as early as the end of November, 1610; and the discovery, or first observation, must have been as early as the summer of 1610, or before Galileo removed from Venice to Florence, the change of residence taking place at the end of August, 1610. It is proved, in fact, by a letter from the friar Fulgence Servita, a theologian of the Most Serene Republic, that he showed the spots to Father Paolo. It is not easy to divine why Galileo, usually so careful of his rights, did not this time make a claim for priority in discovery; but it may be supposed that by the side of the discovery of the Medici stars, Saturn's rings, and the phases of Venus, that of dark points on the sun, changing in character and disappearing according to the position of the star, appeared of trifling importance to him; and this is to a certain extent confirmed by the reply to Welser. Galileo's observations, in fact, did not begin to be known till in 1612; and if we did not trust to his assertions or to ocular testimony, Fabricius, Scheiner, and perhaps others, made the discovery before him; but this would not be a fair judgment. It must be admitted that Galileo first observed the spots on the sun with the aid of the Lippersheim glass; but his earliest notices on the subject did not appear till the spring of 1612, while the earliest publication on it is that of Fabricius, who discovered the spots on March 9, 1611, in complete ignorance that Galileo had observed them eight months before.

The false Apelles pretended that he had observed the spots for the first time, together with one of his pupils, in March, 1611. How, then, could Kepler have written to David Fabricius of "the sun spots seen by your son long before, Apelles," if, as we know now, Jean discovered them in March, 1611? No one was more in the current of events than Kepler, and he was astonished at the letters of Apelles. Besides, Scheiner told Welser that he had observed some darkish things on the sun, but attached no importance to them till October, when he resumed his observations—that is, after Jean Fabricius's book had been published.

It finally appears from Dr. Berthold's book that (1) Galileo was the first to observe the spots on the sun with the Lippersheim telescope in the summer of 1610, but he did not publish his drawings and observations till the spring of 1612. At that time he was master enough of the question of the sun's rotation to correct Scheiner's errors. (2) Jean Fabricius discovered the sun spots on March 9, 1611; he was acquainted with the sun's rotation, and was the first to publish a work on the subject. His discovery is quite independent of any previous suggestion. (3) Scheiner may also have observed the sun spots independently in March, 1611, but he attached no importance to them till October of the same year, after the publication of the Narration by Fabricius. His merit consists in his having continued the observations, and in having collected a large number of them, which were inserted in his *Rosa Ursina*.

The "long before" (*longe ante*) of Kepler is unexplained.—*Translated for the Popular Science Monthly from Ciel et Terre.*

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FOURTEENTH-CENTURY DOCTORS.

By M. E. NICAISE.

DAREMBERG says, in his *Histoire des Sciences médicales*, that the custom of consultations among doctors was extended in the thirteenth century; but it is probable that the usage existed in previous stages of civilization. There have always been grave maladies and hard diagnoses and cases involving considerable responsibilities, for which a meeting of doctors was desirable; and there have always been patients in considerable social station who liked to be taken care of by several doctors at once. Consultations, therefore, have not all the same origin or the same purpose, but the proceedings in them are always the same—examination for what is the matter with the patient, and discussion concerning it and concerning the treatment to be adopted.

On this subject, we have but few documents from antiquity and the middle ages, and of these the work of Mondeville * gives the most information. His work relates to other subjects than surgery, and might, without straining words, be styled Memoirs. Under Philippe the Fair money was scarce, and the doctor and the surgeon were but poorly paid even by the king. "I have never," Mondeville says, "found a man rich enough or honest enough, of whatever condition, religious or other, willing to pay what he had promised without being pressed or forced to do it."

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* Chururgie de Maître Henri de Mondeville (Surgery, by Master Henri de Mondeville), Surgeon of Philippe le Bel of France, composed between 1306 and 1329; translated into French, with notes, an introduction, and a biography; published under the auspices of the Minister of Public Instruction, by E. Nicaise, assisted by Dr. Saint-Leger and F. Chavannes. Paris, 1893, F. Alcan.

His rancor against these patients is so great that he is ready to excuse and counsel even means which we would incontinently reject at this time, to compel them to pay acceptable fees. He does not seem to have put these measures into practice, for he had no fortune; but the fact that a king's surgeon should venture to speak as he does on so delicate a subject casts a curious light on the society of his day and its want of order; on the other hand, his remarks can not be generalized and applied wholesale to the period in which he lived.

Coming to Mondeville's exposition of the method of holding a discussion, we find his description almost a story of what might take place to-day. "First," he says, "we should inquire into the nature of the disease, examining carefully and feeling, because the diagnosis is made by touching with the hand and observing with the eye. All the consultants engage in turn in the examination. Then, if the case demands it, they make a new examination all together, pointing out to one another the symptoms of disease and the special or remarkable features either in the patient or the disease. Then one of them, the highest in rank, says to the patient, 'Sir, we perceive very clearly what is the matter with you, and you ought to have full confidence in us and be glad that there are so many of us here, and such doctors—enough for a king—and to believe that the youngest of us is competent to prescribe and carry on your treatment and bring it to a good result.' Then he interrogates the patient about the circumstances of his attack: 'Sir, do not be displeased or take it ill, but when did your illness begin?' following this with many other questions, the answers to which are recorded as indications furnished by the patient.

"When all the questions called for by the case have been asked, the consultants retire to another room, where they will be alone; for in all consultations the masters dispute with one another in order the better to discuss the truth, and sometimes they come to a pass in the heat of discussion which would cause strangers witnessing their proceeding to suppose there were discord and strife among them. This is sometimes the case.

"The oldest, the most eminent, or the most illustrious of the doctors, if there is any such among them, a king's or a Pope's doctor, should propose that they all speak in turn. If they are all silent, as they would be in the presence of so eminent a chief, he should take the floor and question them, one after another, beginning with the youngest and least famous, and so on, passing always from the inferior to the superior. If the older ones spoke first, the younger and less considerable would have nothing to add, and the consultation would thus be of no effect; while, whatever the younger doctors might say, the older ones would have opportunity, which would be valuable in some cases, to correct it, add to it, subtract, oppose, or applaud it. He should ask them concerning the character of the disease, what it is called, what the experience of experts has been with it, what authors mention it,* and in what part of their works. These questions being answered, he should inquire whether the disease is curable or not, and how. For a simple example in surgery," says Mondeville, "to show better how the thing is done, suppose a tumor on a fleshy part, the shoulder or the thigh, is to be treated: the doctor should inquire of what matter or humor it is formed; whether of the blood, for example. He should then inform himself concerning the disease, its beginning and progress, and ask if an evacuation is not desirable. This being decided upon, of what kind—a bleeding? If yes, in what limb or what vein, when and where; for the practice varies according to the season and the habits of the patients, and according to the aspects of the moon and the heavenly bodies and an infinite variety of things." Such is the regular, decorous consultation, but things did not always go on thus smoothly.

Before repeating what Mondeville says concerning the incidents of consultations, I will expound the sage precepts he lays down for consultation at a distance, a subject to which he devoted a whole *notable.* This is an important point when we recollect that at that time, and thence on down to the sixteenth century, the doctor often gave his advice without leaving his office, without seeing the patient, by examining his fluids and asking some questions of the messenger.† It is not worth while to give all that Mondeville says, but only the principal parts of his chapter, omitting the arguments which he draws from the authors that preceded him. It was one of the characteristics of the period, as I have already remarked, that authors generally rested their opinions, not principally on their own experience and studies, but on what Galen and some Arabian authors said. The respect of some for their predecessors was absolute, and they cared for nothing besides what rested on the authority of these.

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* This was characteristic of the age. Even doctors well instructed and advanced in experience did not venture to rest on their personal opinion, but had always to invoke a predecessor, Galen or the Arabs, as the original authority. Mondeville, however, paid less attention to this custom than some of the others.

† Already at that time famous doctors and surgeons went to see their patients, notwithstanding the diffiulties of communication; Lanfrance, Mondeville, and Guy de Chauliac give us proof of this fact. There were other doctors, clerks, and canons, as were most of the *maîtres régents* of the Faculty of Paris, whose dignity forbade their visiting patients and who gave consultations by interrogating the messenger and analyzing the urine of the patient. This custom disappeared after the reform introduced in 1452 by Cardinal d'Estonteville, who obliged the new doctors regents who received no prebends from the Church, to busy themselves with their patients. The contest of the faculty and the surgeons originated at that time.

Mondeville rose bravely above this principle, but yielded sometimes to its influence, and also called the Arabians to his aid.

On the subject of consultation at a distance, he observes that "people have often asked counsel of us surgeons on the treatment of diseases that we have not seen and can not see, because of the absence and distance of patients who can not be brought to us, while we can no more go to them. Under such conditions, it is neither safe nor conformable to the precepts of the art and of a good conscience to make out a prescription of curative treatment for diseases hard to cure, like cancers, fistulas, etc. It is, however, permissible, after having legitimately excused one's self, to prescribe a palliative treatment. In diseases easy to cure, in recent small wounds—for example, boils, tumors, slight contusions, etc.—we may give a curative prescription to absent persons. We should laugh indeed at surgeons," he adds, "if the patient had to appear personally before them for a light disease as well as for a serious one.

"Possibly the messengers from persons seriously ill will tell us that they know as well as the patient himself all the details of the disease; but this is not possible, for no one can extract facts as appropriate and useful in the particular case as the doctor. The patient would not pay due heed to the questions if they did not come from the doctor; and even if the messengers did exactly describe the condition of the patient as it was—and even this is not possible—they would be wholly, or to a large extent, ignorant of his present state, for it would have changed in the interim." In the proceedings just described things were done correctly, as in our own time, but it was not always so; and there are some statements in Mondeville that throw a curious light on the manners of the fourteenth century.

He represents many persons as choosing their doctor without troubling themselves to know whether he was well taught and experienced; others were not satisfied till they had as many doctors around them as possible. "There are frequently," he says, "Parisians who, when ill, call together a great many doctors of different sects, to consult with them. Some think that the more surgeons they have, the sooner their disease will be cured—the same, for example, as ten masons working together on a wall will accomplish as much in one day as one mason can in ten days. Patients who know how to distinguish among surgeons the one who has the best training and experience prefer to have only one"—and that is Mondeville's advice.

But if complications arise, as a fourth day of fever,* it will be preferable to call two surgeons, "and if possible, let them be friends, of the same sect, and agreeing in opinion; if two such can not be found, then a third should be taken in, in order solely to make the others agree after they have discussed the matter." Mondeville is not a partisan of a large number of consultants. He found many inconveniences and few advantages for the patient at the numerous meetings which he attended as king's surgeon. He then makes an irreverent comparison, of the patient to a dog and the surgeons to its hair: "We are," he says, "like the hairs of a dog: the longer and coarser they are, the more they annoy the animal, because they overload him and furnish a harbor for lice, and are of no use in any way, for dogs seldom die of cold. . . . The more numerous we are," he adds, "the less each one of us feels himself responsible. Each says that no larger part of the treatment fell upon him than upon the others. Hence, the more doctors the sick man has the more he finds that he has few or none. If affairs go ill, every doctor excuses himself, and holds that he is absolved. In this way it often happens that wealthy patients are less effectively treated than poor ones, because of the number of doctors they have around them. On the other hand, a large number of consultants embarrasses the attending doctor, and prevents his following his habitual practice; while, if he does not pay strict attention to the observations of the others, they regard him as a disagreeable, proud, self-conceited man."

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* "Most usually," says Mondeville, "the fever accompanying wounds is ephemeral; but sometimes it changes into a fever of suppuration, and this is to be feared when the

The experienced surgeon, when he is alone, uses processes which he is not willing to reveal to the others (every one keeps his secrets, and every one pretended to have them in those days), or he is afraid that they will reject his remedy, as some do, who will nevertheless make a note of it to use it on occasion. Or, again, if his remedy is accepted, each of them will want to add something to it—one rose, another melilot, a third camomile—whereby the medicine will lose its virtue and the surgeon will not accomplish his purpose, and will be exposed to reproach from the very persons who have nullified his remedy. And, lastly, when the surgeon reveals to others, who knew nothing about them, the conclusions to which his experience has led him, they will say, "That is what I observed a long time ago," or "That is what I was just going to say."

Another argument adduced by Mondeville against a large number of doctors is that an experienced doctor is really seldom mistaken, while it is impossible, when several doctors have come together, for them all to be agreed as to the cause of the disease, its nature, symptoms, and treatment, for there will be as many

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fever is prolonged beyond four days." This is why our author makes the limit of four days intervene before determining it to be necessary to call in another surgeon.

opinions as there are heads. If by chance they should agree upon the purpose to be effected, they will differ concerning the details. One will propose, for example, in the treatment of a tumor, to make it ripen, while another, who had intended to prescribe the same, will say althea and a third ursine, and so on with the others, if there are a thousand of them; then all these drugs will be mixed in the same medicine, although mallows alone would have been the best.

An anecdote is related by Mondeville in illustration of the desire that prevailed in those days to appear to be doing something. During a consultation, when a number of the best doctors in Paris had just formulated a prescription for a sirup, a belated colleague came in. After carefully examining the prescription, he added a berry. On the others expressing surprise, he exclaimed: "Mutton-heads and oxen! why are you looking at me so? How could I conscientiously take my part of the fees if I did not put something in the sirup?"

If the consultants do not dispute over some definite object, they will dispute from jealousy or hatred; and the instant one of them suggests something reasonable and conformable to experience, the others, even though it was what each one of them himself would have recommended if he had been alone, rise one after the other and agree in declaring the contrary of what was proposed.

Mondeville thus describes consultations under two different aspects. The first picture presents the typical, orderly consultation; the second exhibits the daily strifes and rivalries, of which he collects several various types in a few lines. Viewed in this light, the men of the fourteenth century were much like those who followed them, except that they were more brutal and less careful of delicate forms.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

THE progress of Tommy Stringer at the Massachusetts Kindergarten for the Blind affords a remarkable illustration of the power of suitable training to awaken and develop a mind from the darkest obscurity, and when the conditions around seemingly act only to eclipse it Tommy was brought to the institution, four and a half years old, in 1891, blind, deaf, speechless, with no great intelligence, and "not unlike a puppy in some of his instincts and characteristics." He was placed under the charge of a special teacher—and a competent one—who devoted all her time to him. He is described in the last published report of the institution as having become "a fine boy—bright, energetic, manly, instinct with life, erect in stature, innocent as a lamb, frolicsome as a kitten, full of fun and ingenuity, and not destitute even of a tendency to mischief"; pure, honest, intelligent, generous, using tools handily and with good taste, and advancing well in all the branches of education, mental and physical.

SKETCH OF SAMUEL LOCKWOOD.

By W. S. SNYDER.

IN Freehold, N. J., and almost upon the historic ground of the battle of Monmouth Courthouse, in an inviting home built to his liking, lived until January 9, 1894, the Rev. Samuel Lockwood, Ph. D., widely known as a general naturalist, and a shrewd observer and describer of the habits of animals. Such was his retiring and unpretentious nature that the writer had great difficulty in securing his consent to the publication of the story of his life. But long acquaintance and occasional meetings at last thawed the reticence, and I am now, after his death, permitted to give a brief account of it.

Prof. Lockwood was born in Mansfield, England, January 20, 1819. His father, William Lockwood, was a man of devout piety, a leader among the Wesleyan Methodists, and, as a citizen, well versed in public affairs. His mother, who was taken from him at an early age, and for whom he entertained a loving regard, was the daughter of a Moravian exile from Prussia, who became head master of an English endowed school, and was known for his superior artistic tastes and for his engravings on copper. On her death the household in England was broken up, and the father with his little boy started for New York city, where the boy was brought up and received his education. I am unable to give his exact age at the time, but in very tender years the future naturalist began to unfold. A huckleberry party, going into the country one day, were caught in a drenching thunder-shower. Returning in haste to their stopping place, the boy Samuel left the others, and, making a short cut, went by a by-path through a low meadow. Suddenly he paused. Finding a snake lying in the path, and supposing the reptile was dead, he picked it up and carried it home, reaching the house in advance of the others. Before the rest of the party came in, a little boy in the house was taken into the confidence of the young naturalist, who, with the reptile on his lap and a pin in one hand, discoursed to him about the beauty of the scales upon his snake, pointing to their outlines with the pin. So absorbed was the juvenile lecturer in his theme that he was unaware that the entire company had become his auditors.

Young Lockwood's education, with the exception of the bare rudiments, had to be provided by the labor of his hands and brain. He worked his way into the University of the City of New York, where he attracted the attention of the eminent classicist, Dr. Lewis, and of the elder Draper, eminent in physics. With Dr. Henry, the rhetorician, his relation was different. Lockwood had somewhat independent notions concerning the rhetorical proprieties, and, holding college compositions in no high esteem, failed in a corresponding degree to be appreciated by the professor. Yet he was all the time paying his way through college with his pen, being employed as an assistant editor on the New York Sun, then under the control of Moses Y. Beach. Very much surprised was the professor when he learned from one of Lockwood's classmates that he, the member of the class who stood lowest in marks, was thus practically achieving a substantial literary success.

In consequence of an attack of brain fever, Lockwood left college during his sophomore year and retired to the country to recruit. A classmate came to visit him, and during his stay the two youths went for a hunt. They bagged some birds and squirrels, which were carried to the farmhouse where they were staying. The good wife prepared the game for dinner in delicate style, but while the classmate ate with evident relish, Lockwood, although declaring that he was "as hungry as a bear," found his conscience smiting him, and the savory dish seemed only to accuse him of a wicked and selfish slaughter.

Prolonging his stay in the country through the vacation season, Lockwood one day discovered an oriole's nest at the extremity of a provokingly high and long branch of an oak. To get at the nest without destroying the limb was impossible. At the farmhouse he expressed a wish to get the young birds, when an inmate said, in a taunting way:

"I'd like to see a city chap get them birds!"

That was a challenge. He undertook the capture, and by a series of ingenious devices, combined with steady persistence, secured the whole brood.

This incident rooted more deeply than ever the taste of the student for natural history. When his graduation was near, Dr. Draper, the chemist, in whose class Lockwood stood very high, endeavored to impress upon him that it was his duty to enter the medical college. The young man's trend was, however, toward the Christian ministry. This inclination, which became an irresistible desire, was encouraged by the Rev. Dr. Ferris, afterward Chancellor of the University, and Colonel Crosby, father of the late Rev. Dr. Crosby. Mr. Lockwood entered the Theological Seminary of the Reformed Dutch Church at New Brunswick, N. J.

Mr. Lockwood had been privately married soon after graduation from the university, and still kept the fact a secret when he entered the seminary. He soon found himself without resources, and in his trouble had recourse to prayer. Ultimately the singular thought occurred to him, on which he acted at once, of going to a business man in New Brunswick, who was not regarded as generous or liberal, and proposing a loan of one hundred dollars on his individual note. The proposal was accepted, and the financier, taking young Lockwood's hand in his own, wished him God speed.

Immediately after this transaction the seminarian went into a barber's shop, and, while waiting his turn, picked up a city paper which offered a series of premiums for the four best stories on a given subject. Reaching home, he told his wife what he had read. She said, "You must write for the first prize!" The story was written, and won the first prize. It was called The Treasure Hunters, and was written during the California gold fever, but bears not even a remote relation to the Argonauts.

Mr. Lockwood was graduated from the seminary and was licensed to preach in 1850. He received a call to the church at Cortlandtown, N. Y., where he remained only two years, employing for diversion his spare time in the pursuit of natural history, collecting insects and studying animals. In 1852 he was called to Gilboa, N. Y., where, located by the side of the Schoharie, he became deeply impressed with the fossil richness of the region.

A clerical agent for a benevolent society came to Gilboa, and after having succeeded, with Mr. Lockwood's aid, in securing the largest subscription ever given in the church for outside benevolence, was taken by him for a stroll in the fields and by the fossil beds. Mr. Lockwood spoke of the geological aspect of the region and of the great age of the Catskills, when the agent responded that it "was all the work of the flood." "Could the flood," asked Mr. Lockwood, "build up these stony mountains filled with shells for thousands of feet deep? . . . We will let the rocks speak for themselves." Picking up a soft stone from the stream, he dropped it on the rock at the agent's feet, when it broke, revealing a mass of Devonian trilobites. "Now," he said, "these fossils were deposited in quiet waters, and by no turbulent flood. So gently was each one laid by Nature in its bed to die, that not one of the delicate striæ that beautify it was injured or disturbed. But then, why should not the Creator have loved the beautiful before man was made?" "What! what!" exclaimed the agent; "death in the world before man was made? I see! You're an infidel!" The agent's society seems, however, to have overlooked this matter of infidelity, for it made Mr. Lockwood an honorary member in recognition of his services to it.

The young minister was soon reading other "sermons in stones."

Strolling one day along a high bank when the water of the stream was low, he observed some carbonaceous markings. With the aid of hammer and chisel these were proved to be relics of an ancient flora. He extracted from the face of the cliff a bell-shaped stone, the lower part of which was more than three feet in diameter and the upper surface about two feet. It was the base of a shaft of a huge tree fern.

In 1854 Mr. Lockwood was called from Gilboa to Keyport, N. J., and he took with him a careful drawing of the big fossil. About two years afterward he revisited his haunts in the Schoharie Valley, when with other large fossils he removed the one just described, and presented it to Rutgers College. The moving of this mass—some thirteen hundred pounds—over thirty-seven miles of the Catskills was not without incidents. The young student was much annoyed, at points where the horses were fed, by inquiries about the "big stun." His paleontological lecture upon the rock as being the base of a wonderful plant rather puzzled the country people, as at Durham, N. Y., where the most rational theory that could be conceived to account for his proceedings was that the rock contained gold. This theory won respect for the geologist, who was now viewed in the light of a mining explorer.

Mr. Lockwood prepared drawings of his fossil plants, intending to send them to Hugh Miller, when the news came of the Scotch geologist's death. The fossils were studied and described by Sir J. William Dawson, of Montreal, and the descriptions with plates were published. The chief fossil received the name *Caulopteris Lockwoodi*, meaning Lockwood's "wing-shafted" tree fern. Each stem was a symmetrical column of sixty feet in height, with vast fronds like far outreaching wings.

Upon invitation of the late Prof. George H. Cook, then the New Jersey State Geologist, Mr. Lockwood presented the fossil to Rutgers College, with a speech, at a meeting of the Students' Natural History Society, in commencement week.

Mr. Lockwood reasoned out, without aid from books, to the conclusion that, though resembling the Carboniferous fossils, these Devonian plants must have antedated them; and that, though the rocks containing them were superficial in the Catskills, they probably extended, in Pennsylvania, beneath the coal beds. His interest in geology became from this time very lively.

In his new field in Monmouth County, New Jersey, Mr. Lockwood's attention was directed to the Cretaceous deposits known as the marl beds. They exhibited a new phase of organic remains in their vertebrate fossils, attesting to the former presence in the region of a race of immense reptiles quite as wonderful in their way as the Devonian cryptogams of the Catskills. During one of the visits of inspection which he was in the habit of making to the clay bluffs near Keyport, he observed what appeared to be the surface of a broken bone, black and friable.

Working very carefully, he extracted two enormous pieces of bone thickly coated with iron oxide—the distal ends of the fibula and tibia of some very large animal. Examining his find on the way home, he noticed a clean fracture, as if a spur had been broken from the bottom of the tibia, indicating a novel form. He returned to the bluff and extracted the missing piece. This bone was examined by Marsh and Cope, and figured by Cope and described by him as *Ornithotarsus immanis*, or "immense bird-ankled beast." The face of this ankle joint was thirteen inches and three quarters in the longer diameter; and the bones indicated an animal with long hind feet, like those of a bird, and short fore feet, that could stand up and browse upon the high trees of the forests in which it lived. Cope estimated the length of its hind legs at twelve feet.

Mr. B. Waterhouse Hawkins, an English artist skilled in the restoration of fossil forms, had come to this country and made some restorations of ancient gigantic animals—the Hadrosaurus, for instance, at the Academy of Sciences in Philadelphia, and at Princeton College. As he had made restorations of extinct English reptiles for a public park in England, it was thought that a good educational effect would result if a series of restorations of the so much grander extinct reptiles of the Cretaceous period of New Jersey could be set up in Central Park, and this gentleman was accordingly engaged for the project. He had a studio in New York city, where Prof. Lockwood visited him at his work. The artist's plan was, first to reconstruct the entire skeleton from the fossil bones, then to habilitate it in flesh by molding the clay upon it, so that the animal really had a true skeleton inside. Mr. Hawkins had already set up a Hadrosaurus when Mr. Lockwood called, but the visitor noticed that there was a break in the fibula. In answer to an inquiry about this omission, he was told that the beast had a singular articulation of this joint for which the fossil bones gave no data, and the artist had been unable to invent it. Mr. Lockwood modestly said to the artist:

"Why, I can articulate that for you."

Mr. Hawkins was incredulous, and seems to have continued so even after Mr. Lockwood told him he had the articulation at his house. Returning home, Mr. Lockwood made drawings of the part, the receipt of which set the English artist "crazy," as he expressed himself in a letter asking the loan of the bones. With their aid the difficulty was solved. Mr. Lockwood was afterward asked to sell the bones, to be given to the British Museum, but he preferred to keep them for America.

This incident was followed by a very curious psychological experience. Mr. Lockwood received from Mr. Hawkins an original cartoon of the Cretaceous dinosaurs, accompanied by a letter asking him to write a popular descriptive text to it. While his mind was exercised on this subject he was attacked by a violent fever, culminating in delirium. In this delirium he dreamed of a terrific battle of saurians, in which all the giants of the family took part. After recovery from his illness Mr. Lockwood wrote the dream down, and it proved a very satisfactory libretto to the cartoon.

While Mr. Hawkins was still engaged in his saurian reconstruction in Central Park, the "Tweed Ring" rose into power, and, not appreciating the value of this scientific labor, or rather not caring for it unless it was re-enforced by the kind of consideration acceptable to political bosses, ordered the figures, representing the patient labors of two or three years, destroyed. Prof. Henry, of the Smithsonian Institution, intervened to prevent this devastation, but he had no hearing.

Mr. Lockwood's residence at Keyport gave him opportunity to study ichthyic life. As a first result of his researches in this new field appeared his article in the American Naturalist, The Sea Horse and its Young, which describes the remarkable fact that the male fish takes from the female the eggs and places them in an abdominal pouch, in which he carries them until they are hatched. It was upon this discovery, published in 1867, that the University of New York conferred upon her alumnus the degree of Ph. D. Some studies on insects at this time led to economic results.

After reading a paper before the New York Lyceum of Natural History on A New Parasite in the Eel, the society requested the doctor to take up the study of *Limulus*, the horsefoot or king crab. Dr. Lockwood was promised the loan of a compound microscope for the purpose, but this he did not get, and did his work with an instrument which cost but three dollars. The paper was read to the society in 1869, and published in the American Naturalist in 1870. It showed that in one of its embryonic forms *Limulus* is a trilobite. Dr. Lockwood also demonstrated that in successive months of its larval life it went through further phases representing those higher fossil forms known as *Pterygotus*. The author furnished eggs to Prof. A. Packard, who sent some to Jena. The article in the American Naturalist attracted much attention, and pointed out the way to a number of eminent workers on the problem who were able to use the best appliances. Dr. Packard led; then Prof. Dorhn, the biologist of the University of Jena, who translated the Lockwood article into German. Dr. Richard Owen, the eminent English anatomist, occupied two evenings of the Linnean Society of London citing largely from the article and complimenting it. The paper received praise also from Milne-Edwards.

In his studies in fishes, besides some abstruse problems which he attacked, not always with equal success, Dr. Lockwood gave a charming lecture on sticklebacks, which included some descriptions of their nesting and the raising of their young. He also made some discoveries among the mollusks. But perhaps his most extended labor was devoted to the oyster, as is shown in his report published by the State of New Jersey. Upon this subject as a lecturer and writer he won great applause and enduring fame. An amusing incident, which was at the same time a compliment, occurred some years ago when Dr. Lockwood was lecturing on The Life of an Oyster. Two oystermen, at the conclusion of the lecture, got into audible discussion over what they had heard. Said one to the other, "I tell you, Ned, he knows it all, from the cedar on Lebanon down to soft clams!"

Dr. Lockwood's studies were not confined to fishes, but he examined and investigated zoölogy generally. There is also a third phase in his scientific character which must not be omitted. His discovery of the fossil plants in New York led him into the study of living plants; hence he was not without reputation as a comparative botanist. He seemed to see all things as a unit—nothing unrelated—Nature as the oneness of the Infinite Maker. His knowledge of these several fields, which was sharply defined and comprehensive, and his simple yet almost poetic generalization, made everything from his pen attractive to the popular reader.

But back of all was a devout mind, with an overflowing love of any and every living form, animal or plant. In his study his aquarium was always an attractive object to visitors. He even had a little froggery, where different species of frogs enjoyed themselves. Snakes and lizards, too, entered into his friendship, and afforded him opportunity for the study of their habits. Then, with all these, there seemed to be a pathological instinct in the good man's heart. As a microscopist he investigated the diseases of fishes and of plants.

He was fellow of the American Association for the Advancement of Science, President of the American Microscopical Society, and President of the United States Hay Fever Association. His latest contribution to the Manual of the last-named association was an article on The Comparative Hygiene of the Atmosphere in Relation to Hay Fever. An article of similar character was reproduced, together with the plate from the original, abroad, where Dr. Lockwood was well known among scientists, and was an honorary member of the Belgian Microscopical Society.

Speaking of his aquarium, the writer on one occasion observed in a north room of his study several small aquaria, which were the quarantines to which he intrusted the sick animals while making every effort to save them. These aquaria seemed to be divided into sanitaria for different kinds of maladies. On a later visit the doctor was found going over a large number of mounted slides for the microscope which he had prepared, containing fungi and microbes taken recently from sick fishes. Dr. Lockwood's general and specific knowledge in so many fields, with his well-known love for the young and his lifelong experience as an educator, may readily account for the indescribable charm of his writings; but perhaps especially are these features discovered in his two little volumes of Animal Memoirs, of which a third volume, to embrace the reptiles and fishes, was to follow in due course.

Dr. Lockwood lived to be about seventy-five years of age, but time had dealt so kindly with him that his mind seemed to be expanding and ripening as the years went by. His tenacity of purpose in the pursuit of knowledge continued to brighten an intellect that was never dull, while his conversation glowed with the enthusiasm of youth and charmed with a delicacy of thought that was intellectually refining and pure. He was ever a student, but never a recluse. Seated by his beloved microscope, he seemed to play upon science as a master of the violin feels for its magical chords, and he caught by his sympathetic comment upon insect and animal life the attention of his hearers and held it firmly and harmoniously in touch with his own. His fondness for clearness of speech brought him the admiration of those who know science only by name, and his geniality and hospitality won for him the love of all who came within the circle of his home. In his home life he was ever gentle, considerate, and kind, and his love for his work was as absorbing as the simplicity of his life was sweet.

One cause of the persistence of caged birds in singing is found by Mr. Charles A. Witchell in the result of their changed condition of life—that they have nothing to do but to sing. "The wild bird has always plenty to notice and consider—the approach of various creatures: men, beasts, hawks and other birds; the sounds which these produce, and which signify various degrees of safety or of peril; the indications of food in air or tree, or on the ground; and lastly the state of the atmosphere and the various weather signs which all birds observe—such incidents as these occupy the wakeful hours of the wild bird. But the caged bird—often secluded from all communication with his kind (one, perchance, of a gregarious species), without the necessity of seeking food, with a horizon limited perhaps by a smoky garden, perhaps by a dingy window—can take no exercise but in hopping from perch to perch, across and across his cage, and can hear no call-notes but his own, which he repeats again and again, and, if he has been reared in a cage, his own song, which he seems to utter as much for the sake of such occupation as it affords as to express by means of it any desire for a mate or any pleasure in his surroundings."

Correspondence.

THE DEPARTMENT STORE.

Editor Popular Science Monthly:

In the July number of the Monthly, under the head of A New Social Problem, you discuss the department store. I was interested in your application of the fundamental laws of evolution to its development. From an evolutionist whose views do not fully accord with your own will you permit a query or two?

I live in a city in which the first business started was a department store. It was owned and conducted by a wealthy man who was eager for more wealth. Now, how did it happen that his ability to purchase large quantities of goods, the saving of rents, etc., failed to prevent a differentiation and segregation into the little specialist? Has not this been the general course of all communities in this country? First, settlement was made at some point, and the man with a general assortment of commodities put in his appearance. If population became permanent and sufficiently large, differentiation and segregation took place, and the whole became integrated along the street or streets best adapted to business.

Now, what has caused a reversal of the process? The economies mentioned in your article manifestly are inadequate to explain the matter, since all of them have been in operation from the beginning. Take, for instance, the ability to make large purchases for cash. Is it not a well-known fact that the discount to-day in such transactions is less than at any former time? The discount has but two factors—interest and commercial risk. Rates of interest are less than at any former time, while commercial reports are more readily obtainable and more trustworthy than ever before.

Evidently some new factor must be considered, as the forces with which you deal have been in operation for all time. Nor can this new element consist of knowledge of advanced business methods, since it can be shown that we to-day are familiar with no business process not known from the dawn of civilization. This new force, in my opinion, is not far to seek. Is it not true that a high rate of taxation wherever applied has had the effect to concentrate the business in the article so taxed? We need but recall the match, the tobacco and the whisky interests. Now, have we not a new element in the high property tax rates of modern municipalities? They certainly are new, as their equal was never before imposed.

Space will not permit tracing the operations of this new force. But when we observe a direct relation between a high property tax rate and business concentration, we are impressed with its potency. I will instance Chicago. Here we find the highest tax rate of all the principal cities of America; here the department store has attained its greatest development.

From my standpoint, when viewed in connection with the community as a whole, the department store is a dissolution to which the laws of evolution apply precisely as they do to a cancer. It has for its cause the ability of the owner to escape the progressively increasing burden of state. This is effected by making the business so large and complicated as to be beyond the comprehension of the average assessor. The small dealer has no such refuge. The public patronize his rivals in order to obtain untaxed goods. "Only this and nothing more."

The cure is obvious. Remove all tax from personal property (at least), thus giving the small dealer a free field and fair play. This is all "wise legislation" can or should do for him. S. L. Beeler.

Hamilton, Ohio, *July 20, 1897.*

Editor's Table.

A WOMAN ON WOMAN SUFFRAGE.

If the right of women to vote in political elections depended on a demonstration of their ability to think clearly and conduct an argument in an orderly manner, the book which Mrs. Helen Kendrick Johnson has published under the title of Woman and the Republic (Appletons) would settle the question. It happens, however, that Mrs. Johnson is not a woman-suffragist, but that, on the contrary, a wide historical study of the subject has led her to the belief that the party which is laboring to convert women into voters is threatening serious injury to the state both in a political and in a social aspect. Her argument is a very comprehensive one, as a glance at the titles of her chapters will show; and at every point she arrives at the same conclusion, namely, that the woman-suffragists have raised false issues, put forward false pretensions, and generally gone about as far wrong as it was possible to do. We believe—having read the book attentively—that it is destined to have a potent influence in the settlement of the question with which it deals.

The first thing that strikes us in connection with Mrs. Johnson's argument is the high ground she takes on woman's behalf. If she does not claim the suffrage for women it is not that she deems them incapable of forming correct judgments on political questions; not because she recognizes any mental inferiority whatsoever on their part, but because she believes that they constitute that portion of society in whose interest chiefly all laws are enacted and the whole machinery of politics is kept going. We are hardly mistaken in saying that she considers that in the development and perfection of woman the life of society finds its highest significance. The poet Clough had the same thought when he said that men might well

> Perish in labor for her, who is worth the destruction of empires.

The advocates of the suffrage for women will therefore have to attack Mrs. Johnson on other grounds than her depreciation of the female sex. It is they, according to Mrs. Johnson, who depreciate the female sex in asking woman to enter upon a struggle for a position actually inferior to that which she already possesses, a position in which, instead of assuming, as she now may, that laws are made especially for her benefit, she will proceed on the contrary supposition that she can not get common justice unless she wrenches it from man at the polling booth.

Our own view of the general question has been more than once stated in these columns; and it is with pleasure we note how close the agreement is between what we have said, writing from a masculine standpoint, and the conclusions of the book before us, written by a woman jealous for the honor of her sex and instinct with true feminine feeling. Mrs. Johnson perceives, as we do, that law-making means nothing else than the laying down of rules of conduct which are to be enforced, if necessary, by physical compulsion, and that unless we want women to take up cudgels in the most literal sense for the enforcement of laws we should not ask them to take part in making them. Those who vote for laws should not only be possible combatants, but should be individuals whose natures would not be essentially injured by actual physical conflict. Women are *possible* combatants, as the suffragists sometimes remind us, but the essential nature of woman would be injured by participation in physical conflicts. Why can we tolerate prize fights between men, while prize fights between women fill us with horror and disgust? Is it not because Nature itself tells us that whatever woman's physical strength may be—and suffragists sometimes remark with their customary acuteness that some women are stronger than some men—it is not meant to be exerted in delivering blows? But if a prize fight between two women is horrible to think of, what language could be applied to a prize fight between a woman and a man, however evenly they might be matched? Surely "woman's rights" stop short of that. If voting meant merely the collecting of opinions, no one would dream of refusing the votes of women; but so long as it means the determining and arraying of *forces*, which must in the last resort be physical forces, something else than an instinctive desire to tyrannize may well inspire the men who do not wish women to vote. As to the women who do not wish to vote, the simple answer they have to give to inquiring committee women is that they know "a more excellent way."

If the book to which we are referring has a fault it is that it is too argumentative. The author seems to have made up her mind to achieve a victory at every point, and has consequently entered on one or two discussions which might perhaps have been advantageously omitted. We doubt whether it was very necessary to prove that aristocratic institutions are more favorable to the political prominence of women than democratic ones. It is enough to prove, as we think the author has done, that there are reasons for believing that the participation of women in the suffrage to-day, far from improving the constitution of society, would tend to impair it. It was useful, however, to insist that there is no connection between the democratic theory of society and the extension of the suffrage to women. It would be an insult to the female sex to maintain that, in the progressive lowering of the conditions for the exercise of the electoral franchise, women ought to be taken in; or even that, because the franchise is very widely bestowed, women ought to possess it. These unflattering arguments are more or less used by the advocates of woman suffrage; but those who have a truer sense of the position and claims of women perceive that it never can be a question of conceding any right to her *after* men have obtained the same right, or even *because* they have obtained it; whatever is a woman's right belongs to her whether men have it or not.

How odiously in certain cases the suffrage party have stated their position is well shown by Mrs. Johnson in the following paragraph:

"The argument for woman suffrage which bases it upon a fancied grouping of women with the vile and brainless element in the country appears to me at once the weakest and the meanest of all. When the United States Government invited its women citizens to share in making the Columbian Exposition the most wondrous pageant of any age, the National Suffrage Association, at its official exhibit, gave a picture of the expressive face of Miss Willard surrounded by ideal heads of a pauper, an idiot, and a criminal, with a legend recording their belief that it was with these that American men placed American women. So false a picture must have taught the thoughtful gazers the opposite lesson from the one intended. It could have told them that the United States Government had at least guarded one trust with sacred care. The pauper was excluded from the ballot as not being worthy to share with freemen the honor of its defense. The unfortunate was excluded by an inscrutable decree of Providence. The criminal was excluded as being dangerous to society. The women were exempt from the ballot because it was for their special safety that a free ballot was to be exercised from which the pauper and the criminal were to be excluded. They were the ones who have given to social life its meaning and its moral, the ones who give to civic life its highest value."

The writer lays proper stress on the fact that the occasions are not so rare when the authority of law has to be maintained by force, and correctly draws the inference that it would be dangerous to mix up with those who, by their votes, make the laws a large number of non-combatants. We do not find, however, as distinct a recognition as we could wish of the fact that not only *are* laws founded in the last resort on physical force, but that, in the interest of liberty, it is desirable that they should be so founded—that physical force should be fully in view as the final arbiter between those who favor a law and those who are opposed to it. The reason is obvious: if a law *may* have to be fought for, and if there is nothing to deter those who object to it from fighting against it, if it seems unduly to infringe their liberties, and provided they feel themselves strong enough, there will be a reasonable parsimony in the passing of laws, and individual liberty will be the gainer. If, on the other hand, the idea of armed resistance to any law which has once been passed dies entirely out, there will be no bounds to the tyranny of majorities. This is the condition of things which the sharing of the suffrage equally between men and women would tend to bring about. Even to-day laws are being passed, in this country particularly, in vastly too great number, precisely because the instinct of resistance to unjust or unnecessary laws is already weaker than it should be. If we could be sure that it was always "the common sense of most" that kept a "fretful realm in awe" there would not be so much reason to complain; but we have no reason in many cases to suppose that there is anything more than a common desire on the part of a majority to have their wishes and fancies imposed upon others. Men seem to be approximating to women in their belief in compulsion: add the female vote, and liberty, in any wholesome sense, is at an end.

We trust that Woman and the Republic will be widely read and deeply pondered. One advantage which the suffragists possess is that the arguments they use, though very superficial, are specious in their simplicity. It is so easy to ask whether women are not as good as men, whether they are not as cultivated, whether they are not as intelligent; and when affirmative answers are given to these and similar questions, it is so easy to draw the inference that they ought in that case to have equal voting power. The result is that unwary persons are apt to be carried away to an acceptance of the suffragist position. Many men, and some of no mean note, have been so carried away; but the remedy for the error is to look deeper and consider society in its organic character. Prof. Goldwin Smith, as quoted by Mrs. Johnson, expresses the fear lest, through the "feeble facility of abdication" which prevails in a revolutionary era like the present, men may give way to the demands that are being made by the woman-suffragists. Mrs. Johnson shares the fear, but sees also a source of danger in "the very tender-heartedness of the men of our time," adding that, "so far from desiring to hold the slightest restriction over the women of the republic, they may rush into an attempt at abdication of a sovereignty that did not originate in their will, but in their environment, in order to prove the sincerity of their desire that woman should not even *appear* to be compelled to obey." For our part we share both fears; but our special dread is lest the intellectual superficiality of our time should lead to the acceptance of arguments which move, as it were, in one dimension only, the dimension of abstract rights. Any logic-chopper can deal with abstractions, and make of them what he or she likes; it requires a more philosophic mind and vastly more patience and attention to deal with concrete facts and organic systems. Mrs. Johnson's book will repay a careful perusal and reperusal. Whatever errors she may have fallen into upon points of detail—and it is almost impossible that, dealing with so vast an array of facts as she has done, she should not have fallen into some—she has got to the root of the matter. Her formula for man and woman is not, as with the suffragists, $2a$, but ab, each the coefficient of the other, and both together forming a compound unity. Her book rests on the solid ground of Nature, and will survive many dreary diatribes of the $2a$ school of social reformers.

THE DICTUM OF A PHILOSOPHER.

Mr. Thomas Davidson is by all accounts a philosopher. He is profound in Aristotle and Rosmini, and can tell to a shade just where Kant failed to grasp the problem of human knowledge. He has written magisterially on the subject of education. He is therefore a man whose utterances ought to be marked by a very superior wisdom, particularly on the subjects which he claims to have made his own. Strange to say, however, we fail to see any great wisdom, or even, to put it plainly, much sense in a remark in which he indulges in the July Forum. He there discusses the changes that have taken place in England during the last sixty years, and, in doing so, takes occasion to say that "the education of children, which formerly was let out to teachers as the washing of clothes was to washerwomen, is now regarded as a matter *demanding the careful attention of parents.*" If this means anything it means that the giving of clothes to a washerwoman to wash may be taken as a typical instance of a matter that does not receive careful attention—a matter about which people are proverbially indifferent.

Now, we do not claim a very profound knowledge of the household diplomacy which results in the making of treaties with washerwomen; but, so far as any echoes of the proceedings have reached our ears, we have received an impression that very considerable interest is taken in the choice of an efficient washerwoman, and that the subsequent performance of the person selected is watched with close attention. We have reason to believe that questions are very frequently raised as to whether the clothes have been properly treated in the washerwoman's hands; and that if they come back unsatisfactory in color, badly ironed or folded, or showing signs of excessive use of alkali, sharp remonstrances are made. If the case is serious, the clothes are not again given to the inefficient or destructive operator, but search is at once made for one who will do the work better. If we are not up to date in our notions on this subject, we are sorry for it; all that we can say is that it used to be so. What are we to say, then, to the learned professor's typical example of slipshod indifference? Only this, that it was very ill-chosen, and that the professor is evidently more at home on the dizzy peaks of a transcendental philosophy than in the region of domestic economy.

The real truth is that, in these advanced days, a contrast might well be drawn between the care and sense of personal responsibility people manifest in getting their clothes washed and the easy-going confidence and careless irresponsibility with which they send their children to be educated. One reason for the difference is that they pay directly for the former, and only indirectly, and in a manner they can not control, for the latter. In the former case they want to get value for the money they pay out; in the latter case if they don't get value they can not do anything about it; the whole thing has passed beyond their control, and is largely in the hands of ward politicians. So the children go to school and come home; and the average parent hardly asks what they have learned or whether they have learned anything. It was long ago remarked by Adam Smith that "the proper performance of every service seems to require that its pay or recompense should be as exactly as possible proportioned to the nature of the service." That is the case with the washing of clothes, but it is not the case with the education of children. The parents who pay the money have nothing to say as to the quality of the article they get in return; and superintendents and trustees are only able to a very imperfect degree to proportion compensation to the amount of useful work done. Upon the whole the "washerwoman" system has its good points; and, disagreeing with Prof. Davidson, we should be very glad if it could be made applicable to the whole business of education.

THE DEPARTMENT STORE.

A CORRESPONDENT regards as inadequate the recent explanation given in these columns of the origin of the department store. Instead of attributing it to the economies it effects as a piece of labor-saving machinery, which has come into existence under the operation of the law of evolution, he ascribes it to the influence of the heavy municipal taxation that prevails in the United States. In proof, he cites the failure of the department store, or rather the country store, in new communities to prevent the growth of the specialist. He cites also the city of Chicago, saying that "here we find the highest rate of taxation of all the principal cities of America," and the highest development of the department store.

That heavy taxation, as was shown in the case of the match and whisky industries during the civil war, tends to concentrate business in a few hands with large capital we would not deny. Nor would we deny that such concentration is abnormal and injurious. But while we are willing to admit that further municipal taxation in this country has become very heavy and ought to be materially reduced instead of increased, as the tendency is, owing to the extension of the sphere of government, we are not convinced that it has become great enough to produce the department store. Were that the case, the department store would not be the only form that the concentration of capital would assume. Other industries, subjected to the same influence, would also become consolidated. But, as yet, we have heard of no complaint of this kind. What convinces us that this view is correct is the fact that the rate of taxation in Chicago, where the movement against the department store has assumed the greatest proportions, is not higher than in many other cities where there is no serious complaint against this form of industrial development. A reference to the Abstract of the Eleventh Census and to the World Almanac will show that the rate of taxation in Boston, New York, Cincinnati, Baltimore, San Francisco, and elsewhere is higher than in Chicago.

The failure of the so-called department store in new and growing communities to prevent differentiation and segregation is not difficult to explain. In such communities the retail trade is not, as a rule, in the hands of men of commanding ability and enterprise, alert to seize every opportunity to extend their business. If they do possess these qualities, they either go into some other business or move to a larger town. The consequence is, that in the smaller towns the business of the general merchant does not grow beyond his limited capacity. If it does, there are differentiation and segregation. Men more capable in certain lines set up drug stores, grocery stores, hardware stores, etc. But when there is a large concentration of population, making a concentration of trade so profitable as to attract men of the highest ability, then the department store proper is certain to make its appearance. It should be remembered, moreover, that such a store, like any valuable labor-saving appliance effecting important economies, has to be discovered by some superior mind. Only within recent years has any one thought it possible to unite deliberately under one management a large number of forms of retail business. But, as we pointed out in the article criticised, there appears to be a certain limit to this phase of industrial development, thus making superfluous the efforts of the "new" social reformers to cure the "evil." Even if it were due to heavy taxation, as our correspondent suggests, the remedy would be simply a reduction in public expenditures.

Scientific Literature.

SPECIAL BOOKS.

The author of *Bird-life* * will not be offended if we begin our description of his book by a mention of the illustrations, for he has himself expressed his high appreciation of Mr. Thompson's remarkably spirited and accurate portraits. There are seventy-five full-page plates representing birds described in the text, with natural surroundings and in characteristic poses. Twenty-five smaller figures are scattered through the preliminary chapters. Mr. Chapman begins by pointing out the position of the birds with respect to the other classes of the animal kingdom. The different forms of the chief external organs in different birds he shows to be adapted each to a special habit, thus affording confirmation of the doctrine of evolution. He represents the interest of man in birds as threefold—scientific, economic, and æsthetic—and presents definite evidence as to the value of the small birds in destroying insects and the seeds of weeds, and of hawks and owls in keeping down field mice and other vermin. Some of the scientific aspects of the coloration of birds are pointed out in another chapter, and the migrating and nesting habits are similarly treated. Coming to the subject for which the book will be most in request, Mr. Chapman insists on definite observation of a bird as the first requisite to its identification. Having noted down the form, color, and markings of the bird, and such added facts as to its voice and actions as may be obtained, the amateur should be able, by means of the author's field key of eight pages and the detailed descriptions that follow, to identify the specimen without difficulty. The descriptions are attractively written, and embrace over one hundred of the commoner birds of eastern North America. "There are results to be derived from the study of birds," Mr. Chapman remarks, "that add to our pleasure in field and wood, and give fresh interest to walks that before were eventless; that quicken both ear and eye, making us hear and see where before we were deaf and blind. . . . I would enter a special plea," he continues, "for the study of birds in the schools; for the more general introduction of ornithology in natural history courses. Frogs and crayfish serve an excellent purpose, but we may not encounter either of them after leaving the laboratory, whereas birds not only offer excellent opportunities for study but are always about us, and even a slight familiarity with them will be of value long after school days are over."

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* Bird-life. A Guide to the Study of Our Common Birds. By Frank M. Chapman. With Drawings by Ernest S. Thompson. New York: D. Appleton & Co. Pp. 269, 12mo. Price, $1.75.

The character of history is undergoing a most gratifying elevation. Formerly its chief function was to chronicle battles, assassinations, and slaughters, but it is coming more and more to depict the social, political, economic, and intellectual progress of man, to which wars are deplorable interruptions. In describing that movement of thought whose culmination is the greatest intellectual event of the nineteenth century, Mr. *Clodd** is writing the highest kind of history. No theory of the first rank has ever sprung complete from the brain of one man, hence it is not strange that conceptions leading up to the doctrine of evolution were formed in the minds of philosophers who lived in the intellectual day that preceded the dark ages. Following Prof. Burnet's Early Greek Philosophy in his survey of the thought of this time, Mr. Clodd takes the belief of Thales that each thing is formed by a change from something pre-existent as the earliest recorded germ of the evolutionary theory, and points out developments of this idea in the writings of other philosophers down to Lucretius. After Lucretius came the period denoted by our author as the Arrest of Inquiry, extending from A. D. 50 to A. D. 1600. Toward the end of this period Columbus, Copernicus, Vesalius, Brahe, and Bruno appeared as forerunners of the renascence of science. From 1600 to about 1830 the work contributing most conspicuously to scientific progress was done by Linnæus, Buffon, Cuvier, and Lamarck. Buffon taught the nonfixity of species and Lamarck worked out a general theory of descent. At and after their time lived two or three men who are remembered not for any constructive work that they did in science, but for being "anticipators of Darwin," because they stated, without proofs, an outline of the evolutionary doctrine earlier than 1858.

But it is modern evolution in which Mr. Clodd's readers will be most interested, and he does well to devote full half of his volume to the work of Spencer, Darwin, and Wallace, and their exponent Huxley. Beginning with Darwin, the author tells the chief events of his life, giving the dates when his notable statements as to organic evolution were made and describing the reception that they met with. Each of the others is treated in a similar way, and, in the case of Spencer, dates are given which prove that he had formulated the general doctrine of which Darwinism is a part before the views of Darwin and Wallace were made public. In describing the work of these men and giving a general view of their relations to each other—both intellectual and personal—Mr. Clodd has performed a valuable service. He seems to be solicitous—perhaps more so than becomes one of a victorious party—to refer to the obstacles that theologians have vainly thrown in the path of the evolutionists, and to point out the positive statements in the Bible which modern knowledge no longer permits to be accepted literally. His chapter on the Arrest of Inquiry is, for the most part, an effort to show that the Christian religion was "an arresting force in man's intellectual development—the chief barrier to the development of Greek ideas." We can not accept this view. Christianity is no more the cause of the dark ages than it is of the enlightenment that has followed them. Both are stages in the evolution of mankind in which Christianity has degenerated and has achieved a new birth side by side with science and philosophy and art. He takes unnecessary pains also to state the religious views, or the lack of them, of the men whose work he describes. This will seem to many a blemish on an otherwise instructive and attractively written book. Excellent portraits of Darwin, Wallace, Spencer, and Huxley add to the value of the volume.

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* Pioneers of Evolution, from Thales to Huxley. By Edward Clodd. New York: D. Appleton & Co. Pp. 274, 12mo. Price, $1.50.

GENERAL NOTICES.

No attempt to solve fundamental questions is indulged by the author of this book.* His efforts are devoted to exposing the fallacies of those who become ingulfed in biological theory. He examines their methods critically, and generally disapproves of them. There is inner confusion in the science of biology on account of its form, which embraces numbers of independent systems, each with a core of facts. There is outer confusion, because of its ambiguity of terms. The structure of to-day is the function of to morrow. The favorite inquiries—Are acquired characters inherited? or, Is variation purposive?—are misleading. He asks what quality is not inherited, or not acquired; or, find anything organic not purposive. For the discussion he defines biology not as an encyclopædia of facts about organisms, but as including the systems of explanation of the forms, functions, and origins of animals and plants. He finds twenty good theories of the development of the individual, not any one better or worse than the rest. All bioogical systems are considered as involving three postulates—the independence of qualities, the doctrine of agents, and theories of the use and adaptation of structure. Under the first head we are confronted with the fact that groups of qualities are inherited together. The theories, however, ignore what they call the correlation of qualities and escape by means of terminology; two qualities invariably combined are one. So, in regard to the cell theory. The fact that every thing living is a cell, or a colony of cells, is usually so stated as to evade the problem of the individual. "Functionless parts" and "latent qualities" are also biological bewilderment, and "a mathematical, chemical, or physiological formula for the character of a species is an attractive but vain dream." According to the second postulate, the qualities of the organism are related to one another through an agent. This may be "a material vehicle of hereditary qualities," or a "quasi-psychical principle." The epigenetic theory avoids both of these suppositions, and is deemed by the author the critical point of view. He gives an outline of the theories of the preformationists, or "biologists of hypothesis" as he terms them—De Vries, Spencer, Weismann, Naegali, and Brooks—and pronounces Mr. Spencer's, in two respects, the most serious and credible of all. Yet this contains a self-contradiction on the point of identity and fails to give us individuality. The third postulate supports the adaptation and transformation of species and cruder forms for the doctrine of design. "As ridiculously inapt for science, as that grass grows for cows to feed upon." Theories of organic evolution arose from an effort to combat this philosophy. Everything organic exists by reason of its significance to the organism, but it does not do so through the Darwinian or other apparatus. As to the struggle for existence, the author judges that the view of this conflict is, "as regards Nature, quite gratuitous, and, as regards science, quite abstract." Biologists, however, do not monopolize the conception of a struggle. "Ideas are represented mobbing round the trapdoor under the stage." Motives, faculties, tendencies, movements, all wrestle together. "In all these cases the *struggle* is not what happens, or what we see, it is the result of the struggle. We have to do with a hypothetical process which we do not observe, and the nature of our judgment is that we mistake ideal abstraction for physiological analysis. The concluding chapter is upon the unity of the organism. The beginning and end of our labor is to find an expression for character. What is it, as distinguished from the characteristics? No answer to this problem is suggested, except by the biological theories which have been dissected. The author did not aim to construct, but to show what errors are developed through the needs of speculative systems. The book is thus mainly an addition to the voluminous literature of biology, and it serves well as a corrective to an overdose of theoretical abstractions.

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* Problems of Biology. By George Sandemann. New York: The Macmillan Company. London: Swan, Sonnenschein & Co. Pp. 213. Price, $2.

A pamphlet of about sixty pages, presenting a new hypothesis concerning the structure and rotation of the earth, modestly published by *Carl Freiherr Loeffelholz von Colberg* at Munich in 1886, has passed through a second edition, and now appears thoroughly revised and enlarged as the exposition of an elaborate theory.* The theory is that the crust of the earth, through the natural difference in the action of the sun's attraction and centrifugal motion upon the two parts, has a motion of its own, different from that of the fluid nucleus beneath it, causing it to slip over it to a greater or less extent, and giving rise to a variety of phenomena which have been observed, but not hitherto explained. In this way the author would account for the shiftings of the pole which geologists have had to suppose; for the changes of climate of which evidence is given by the fossils, particularly by the subtropical fossils in the arctic regions, and —probably—for the nutations in latitude which are now under investigation. He assumes that it is a strong evidence in favor of his theory that it contradicts no natural laws or phenomena so far established, but is entirely in harmony with most geological and biological and many astronomical observations.

Although the author states that this work* must not be considered as a petrology, he devotes nearly half of it to describing the several varieties of igneous, aqueous, æolian, and metamorphic rocks, telling how they occur, and what are their constituents. Both the macroscopic and microscopic structure of these rocks are shown in photo-engravings from specimens, and their chemical constitution appears in the results of many analyses. The especial purpose of the work is to set forth the processes and results of the natural decomposition of rocks exposed to the atmosphere. After describing the chemical action of water and the air, the mechanical action of water and ice, and the effects produced by plants and animals, Prof. Merrill proceeds to discuss the weathering of typical rocks in special cases—for instance, a granite in the District of Columbia, syenite in Arkansas, diabase in Massachusetts and Venezuela, basalt in Bohemia and France, diorite in Virginia, etc. Various physical conditions that affect the weathering process are next discussed, such as position, exposure, surface contours, structure of rock masses, etc., and there is also a chapter on the rate of weathering as influenced by such conditions and by climate, topography, etc. The remaining hundred pages of the work are devoted to a description of the regolith or body of soils that mantles the solid crust of the globe. The author points out the various kinds of deposits of unconsolidated material that make up the regolith, and tells something of their chemical, mineral, physical, and other characteristics. The volume contains a total of twenty-five plates and forty-two smaller figures, and the mechanical execution of both illustrations and letterpress is excellent.

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* Die Drehungen der Erdkruste in geologischen Zeiträumen (Revolutions of the Earth's Crust in Geological Ages). A new geologico-astronomical theory. By Carl Freiherr Loeffelholz von Colberg. Munich: J. A. Finsterlin's Successors.

* A Treatise on Rocks, Rock-Weathering, and Soils. By George P. Merrill. New York: The Macmillan Co. Pp. 411, 8vo. Price, $4.

The secret of Darwin's strength, according to Prof. *Poulton*,* lay in the perfect balance between his powers of imagination and those of accurate observation. His hereditary endowment unquestionably fitted him to become a typical scientific discoverer, whether or not this nice adjustment of the creative and critical faculties would have produced equally well a poet or a historian, as it is claimed here. It is a noteworthy example, however, of the immeasurable stimulation of thought that both Darwin and Wallace should ascribe to a reading of Malthus's Essay on Population the discovery of the principle of natural selection. Wallace constructed almost the whole of the theory in two hours, and in three evenings finished his paper on the subject. Darwin devoted four years of study to the hypothesis before writing it out fully, two years more to the collection of further data and enlargement, and after fourteen years of deliberation gave the theory to the public in the Origin of Species. The effect of this doctrine upon Lyell, Gray, Hooker, and other scientific men, the misunderstanding and opposition it incurred, the position of Huxley in regard to it, and his noble championship of the fundamental truth of evolution, are topics of especial interest discussed by the author. Brief accounts of other works of Darwin, some letters not heretofore published, and an index are also included in the volume, which, for the most part, was first given during 1894 and 1895 in the form of lectures in Oxford University Museum.

A most valuable and scholarly contribution to Egyptology is *Religion of the Ancient Egyptians*, by *Alfred Wiedemann*. Written by a professor in the University of Bonn, the subject is handled with German thoroughness and accuracy. He does not theorize on the religion, maintaining that to be fruitless in our present limited state of knowledge of the subject; he investigates the data found in the records and inscriptions concerning the beliefs of a people whose whole life was dominated by religion. The writer's aim "is a modest one; avoiding any attempt to interpret or to systematize, he has endeavored to set before the reader the principal deities, myths, religious ideas, and doctrines as they are to be found in the texts, more especially dwelling on such as have important bearings on the history of religion." The worship of the sun occupying an important place in the Egyptian ritual, the sun god Ra is discussed at some length, together with the solar myths, and the subordinate deities entering into them. There are chapters devoted to the other deities, both domestic and of foreign origin, the worship of animals and plants, Osiris and his cycle, and the Osirian doctrine of immortality, magic, sorcery, and amulets. The author has admirably succeeded in getting order out of the complications of the Egyptian pantheon in which the many deities of the numerous provinces entered, each province claiming superiority for its own deity. Many passages have been translated from the Book of the Dead, hymns and sepulchral texts, and numerous illustrations from the monuments accompany them.*

The author of I Diseredati † believes that outer material influences, instead of being the single predominant factor in social phenomena, as is commonly believed, are only one of several concomitant elements of which the social fact is the resultant. He seeks to present in their exact proportions the importance of the material element in social development, and the influence exercised by it upon the institution of property. The error pointed out is supposed to be accompanied by grave consequences in legislation and practical life. In the former, civic capitalism has been created, and the doctrine has been inculcated that the state should provide for everything, depriving the individual of his initiative and responsibility. The institution of wages is condemned as disorganizing to the family, demoralizing to the workman, and making his future uncertain; and by the institution of rents and the system of day's work, the peasant is made as proletary, as separate from his family, and as destitute of a morrow as the workman in the shop. Thus pushed out of society, such individuals demand a new social order. Society dismayed contrives laws to meet the demands of the workmen for relief, and thus assists in establishing the collectivism which the socialists invoke. Socialism is consequently an evolution or degeneration of capitalism. This evolution is right if it conforms itself to the laws of being, wrong if it does not take account of them. The author's purpose is to show how the necessary, evident, and near evolution of capitalism may take just forms, which, not depriving any, will give their rights to all, particularly to the disinherited; creating a new judicial and social order upon the existing physical order, but unknown to it.

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* Charles Darwin and the Theory of Natural Selection. By Edward B. Poulton, F. R. S. New York: The Macmillan Co. Pp. 224. Price, $1.25.

* The American supply of the work is imported by G. P. Putnam's Sons, New York, 1897.

† I Diseredati e i loro Diritti (The Disinherited and their Rights). By Pietro Pellegrini. Borgo a Mozzano, Italy.

The New York State Library has just issued its seventh annual *Comparative Summary and Index of State Legislation*, covering the laws passed in 1896. Each act is briefly described or summarized and classified under its proper subject head, with a full alphabetic index to the entries. Perhaps the most important legislation of the year was that enacted by the people directly through their votes upon the numerous constitutional amendments submitted to them. The bulletin records the amendments defeated as well as those adopted, a special table arranged by States being inserted for convenient reference. It is of interest to note that of fifty-seven separate constitutional amendments voted on only twenty-four were adopted. It is proposed that the eighth bulletin shall consolidate into a single series with the legislation of 1897 the summaries for the preceding seven years.

A History of Ancient Greek Literature, by *Gilbert Murray* (New York: D. Appleton & Co., 1897, $1.50), forms the initial volume of the Literatures of the World Series. Edited by Edmund Gosse, who writes the general introduction, the aim of the series is to present "a succession of attractive volumes, dealing with the history of literature in a single country," not from the point of view of the specialist treating certain epochs, but giving a survey of the general evolution of thought expressed in artistic form. The object being primarily to give a biography of the intellectual life of a race, "an effort will be made to recall the history of Literature from the company of sciences which have somewhat unduly borne her down—from philology in particular, and from political history. . . . Literature will be interpreted as the most perfect utterance of the ripest thought by the finest minds, and to the classics of each country rather than to its oddities, and rather than to its obsolete features, will particular attention be directed." Homer stands, then, at the head of Greek literature, as being the oldest classic extant in the language. Much attention is given to the historians, and the drama, of course, is extensively treated, as are also the song-writers, whereas less space is accorded to philosophic and political writings. The author has in every case endeavored to get at the personality of the Greek writers and to set down their work as the result of the strenuous life of the people. The chapter on the later literature, Alexandrian and Roman, showing the rich fruitage of its declining years, in poetry up to the sixth century A. D., and in prose to the fall of Byzantium, proves that Greek literature by no means died with the loss of Greek independence, as is commonly assumed.

Dr. *George A. Williams* has prepared a revised and enlarged edition of his *Topics and References in American History*. The topics begin with the prehistoric period and come down to the election of 1896. Each has one or more references to standard works or to leading magazines, and lists of questions are inserted from time to time. In choosing his references the author has recognized the recent demand that students of history shall go "back to the sources." (Bardeen, $1.)

In a pamphlet on *The Energy of Living Protoplasm*, Prof. *Oscar Loew*, of the Imperial University, Japan, seeks to define that elusive mystery, the source of vital activity. Starting from the observation that the chemical properties of dead and living cells are totally different, and that certain substances, toxic to living protoplasm, have no effect whatever on common proteids, he has made a study of the formation of albumin in plant cells, and finds there is a labile or *active* albumin in living matter chemically unlike the ordinary albumin stored in seeds and eggs. This exists as a reserve material in plants and undergoes chemical change by the same influences causing death to protoplasm. By many experiments it is shown that the chemical activity of cells is akin to the phenomena of catalysis. The conclusion is reached that there is an oscillation of atoms, or peculiar mode of motion, existing in labile proteids which is the source of *vital activity ;* this being in its turn "but one of the vicissitudes of solar energy." (Keegan Paul, Trench, Trübner & Co., London.)

The Bureau of Navigation of the United States Navy Department has issued a chart of twelve colored plates showing a *Classification of Clouds for the Weather Observers of the Hydrographic Office.* It is for sale at 40 cents.

PUBLICATIONS RECEIVED.

Agricultural Experiment Stations. Bulletins and Reports. Connecticut: Tests of Plant Food. Pp. 11.—Iowa : Stomach Worms affecting Sheep. Pp. 4.—New York : Sample Road Building. Pp. 2.—North Dakota : Climate and Crop Service. June, 1897. Pp. 8.—Purdue University, Indiana : Formalin for Prevention of Potato Scab. Pp. 20. —United States Department of Agriculture : The San José Scale and its Nearest Allies. By T. D. A. Cockerill. Pp. 29.—Wyoming : The Composition of Prepared Cereal Foods. Pp. 16.

Archibald, Douglas. The Story of the Atmosphere. New York : D. Appleton and Company. Pp. 194. 40 cents.

Atwood, John. Constituents of the Universe. San Diego, Cal.: J. E. Friend. Pp. 65.

Abbe, Cleveland, Editor. Monthly Weather Review, April, 1897. Washington : United States Department of Agriculture. Pp. 64. 10 cents.

Bailey, L. H. The Principles of Fruit Growing. New York : The Macmillan Company. Pp. 508. $1.25.

Bell, Alexander Graham. The Science of Speech. Washington : The Volta Bureau. Pp. 56. 50 cents.

Bulletins, etc., of Scientific Societies. Colorado State Agricultural College : The Birds of Colorado. By W. W. Cooke. Pp. 143.—Field Columbian Museum, Chicago : List of Mammals from Somaliland. Pp. 155, with plates —Tokyo, Zoölogical Society of : Annotationes Zoölogicæ Japonensis. Vol. I, Parts 1 and 2. Pp. 72.—University of Upsala, Sweden : Bulletin of the Geological Institution. Edited by J. Sjögren. Vol. II, Part 2, No. 4. Pp. 172.

Christison, J. Sanderson, M. D. Crime and Criminals. Chicago : The W. T. Keener Company. Pp. 116. $1.

Clayton Air Compressor Works, New York. Compressed Air and the Clayton Air Compressors. Pp. 106.

College and School Catalogues, etc. Baltimore Medical College : Annual Announcement, 1897–'98. Pp. 31.—Columbia University College of Physicians and Surgeons : Announcement, 1897–'98. Pp. 57.—The Neff College of Oratory, Philadelphia : Booklet and Prospectus. Pp. 48. —State Normal School, Valley City, N. D. : Announcement, 1897–'98. Pp. 46.

Hepner, Adolf. Centenary of Faust Zueigung. Goethe's Dedication of Faust. The Author : 806 Chouteau Avenue, St. Louis. Pp. 16.

Hopkins, T. C., and Siebenthal, C. E. The Bedford Oölitic Limestone of Indiana. Indianapolis. Pp. 427.

Jones, Jenkin Lloyd. Ten Noble Poems. Chicago : Unity Publishing Company. Pp. 48. 25 cents.

Mathews, F. Schuyler. Familiar Features of the Roadside. New York : D. Appleton and Company. Pp. 269. $1.75.

Mystic Oral School. Report to the Legislature of Connecticut. Pp. 8.

Newman, K. Antisepsia Intestinal. Maniera de Realizarla (Intestinal Antisepsis ; How to Effect it). Santiago de Chile. Pp 21.

New Orleans Catholic Monthly. Memorial Number of Archbishop Janssen. Pp. 27.

Reid, G. Archdall. The Present Evolution of Man. London : Chapman & Hall. Pp. 307.

Reports and Memoirs. Alabama Geological Survey : The Valley Regions. By Henry McCalley. Part II. Coosa Valley, Montgomery. Pp. 862, with map.—The Fish and Fishes of the Coastal Waters of Florida. Washington : Fish Commission. Pp. 80.—Henry Draper Memorial. Miscellaneous Investigations. By H. C. Pickering and M. Fleming. Cambridge, Mass. : Harvard Observatory. Pp. 90, with plates.—Iowa Geological Survey. Vol. VI. : Lead, Zinc, Artesian Wells, etc. Pp. 487.—New Jersey : Annual Report of the State Geologist for 1896. Pp. 377, with maps.—Peabody Museum of American Archæology and Ethnology : Cave of Loltun, Yucatan. By Edward H. Thompson. Pp. 24, with plate. —Tennessee : Sixth Report of the Bureau of Labor, Statistics, and Mines, 1896. By A. H. Wood. Pp. 318.—Wisconsin : Sixteenth Report of the State Board of Health. Pp. 198.—United States Bureau of Ethnology : Fifteenth Annual Report, 1893–'94. Pp. 356.—United States Commissioner of Labor. Eleventh Annual Report, 1895–'96 : Work and Wages of Men, Women, and Children. Pp. 671.—United States Life-Saving Service, 1896. Pp. 583. —United States Weather Bureau : Report of the Chief. Pp. 266.

Reprints. Davis, William Morris, and Curtis, G C. The Harvard Geographical Models. Boston : Society of Natural History. Pp. 24, with plates.—Drummond, Andrew T.: Some Workingmen's Problems. Pp. 8.—Franklin Institute : Discussion on the Smoke Nuisance and its Regulation. Pp. 76.—Mearns, Edgar A. : Descriptions of Six New Mammals from North America. Pp. 6.—Merriam, C. Hart : A New Fur Seal or Sea Bear (*Arctocephalus Townsendi*) from Guadalupe Island, Lower California. Pp. 4.—Ries, Heinrich : The Fuller's Earth of South Dakota. Pp. 3 ; The Clays and Clay working Industry of Colorado. Pp. 5.—Shufeldt, R. D. : On Fossil Bird Bones obtained by Expeditions of the University of Pennsylvania from the Bone Caves of Tennessee. Pp. 6.

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Taber, Henry M. Faith or Fact. New York : Peter Eckler. Pp. 347. $1.

The Temple. July, 1897. The Rosy Cross. By Rosicrucian. Denver, Col. : The Temple Publishing Company. Pp. 30. 10 cents.

Tucker, Gilman H. Education from a Publisher's Standpoint. American Book Company. Pp. 23.

Fragments of Science.

Ups and Downs of the Tussock Moth.—After the English sparrows had quite exterminated the voracious measuring worms that used to make our city trees naked, the uneatable tussock moths took advantage of the opportunity and filled the trees for a few years with their uneatable larvæ. Now the tussock moths have nearly disappeared, and A Study in Insect Parasitism, by L. O. Howard, entomologist of the Department of Agriculture, tells us how it came about. It appears to be a kind of process of Nature that as soon as any living thing becomes numerous parasites find it, and shortly reduce it to its normal proportions or below. These in turn are subject to secondary parasites which keep them in check. Thus twenty-one parasites have been found upon the tussock moth, with fifteen hyperparasites. While, after having passed its culmination in the farther Eastern cities, the proportion of tussock moths has been about the same, it took a rapid and enormous increase in Washington in 1895. But the parasites appeared in force with the third generation of that year; and when in September several species of trees had been cleared of leaves and others badly injured, "it was an exception to find a healthy caterpillar which one of them was not engaged in stinging." There was a moderately abundant hatching of caterpillars in 1896, but the parasites were ready for them, and the first generation was practically exterminated by them. In the later months of 1896 the hyperparasites took their turn, and the tussock-moth caterpillars were not so hard to find, but were still rare. Even where parasites do not step in to keep down increase, the excessive multiplication of animal pests is at length inevitably checked by disease. Thus the chinch bug has no parasites, "but when it increases beyond the bounds of what may be called Nature's law, for want of a better term, bacterial and fungous diseases speedily carry it off."

Objects of National Forestry.—The policy and aims of those who are seeking the establishment and maintenance of a national forest policy have been misunderstood and misrepresented; and the misapprehension has been strengthened by some glaring defects in some of the forest laws, which the friends of forestry do not approve and desire to have remedied. It is not by their work, but contrary to their intentions, that these laws embody no provisions by which citizens can obtain wood from the public domain by purchase, and that timber-stealing flourishes under their operation. The laws which they propose are designed to remedy these evils. Reservation is the first purpose sought in them, regulation of the use of the timber the second; perpetuation of a valuable resource for coming generations the object. The programme of those urging these laws, as defined by Mr. B. F. Fernow, chairman of the American Forestry Association, is to withdraw from sale or entry all lands not fit or needed for agriculture and to constitute as objects of special care by the Government the lands at the head waters of streams and on mountain slopes in general; to permit prospecting, mining, and other operations under such regulations as will prevent unnecessary waste, and to cut and sell the timber under such methods as will secure perpetuation and renewal of the forest growth; to provide for protection against fire, theft, and unlawful occupancy; to respect all existing vested rights and arrange an exchange, if necessary, for private lands included in reservations; and, finally, to restore to the public domain for entry all lands that are found in the reservations fit for agriculture. The interests of the miner, the lumberman, the settler, and every citizen in the present and the future are regarded in the policy they advocate; the free herding of sheep, by which forest tracts are destroyed and rendered unfit for renewal, being the only industry not considered. "Just like the proverbial incompatibility of the goat and the garden, the growing of wool and wood on the same ground is incompatible."

Sewage Purification by Filtering.—Filtration through the soil is regarded by M.

Vincey, of the French School of Agriculture, as hygienically and economically the most perfect. The work is done through the nitric oxidation of nitrous organisms effected, independent of vegetation, by special microbes contained in the soil. The nitrates thus formed, combined with the very soluble bases contained in the earth, are taken up as foods by plants or carried off in drainage waters. The purifying quality of the soil is not augmented by the production of crops upon it. The siliceous sewer beds of Gennevilliers, near Paris, dug up and ridged, without crops, are capable of absorbing and purifying 1,200,000 cubic metres of sewage per hectare (about two acres and a half) a year. Agriculture is regarded as of great importance in the economy of sewer beds, but not so much on account of its relations to purification as to the quantity of water which the ground can receive. The demands which the most thirsty crops can make upon the water constituents of sewage are, however, limited; and they absorb only a fraction of the amount poured upon the beds. M. Vincey's observations in the Agricultural Park of Asnières indicate that forest land is capable of usefully purifying at least as much water as the natural meadow; and it results from all the experiments that, for a like soil and equal volumes of sewage, a smaller surface of meadow or forest is required than, for instance, of kitchen-garden crops. Siliceous soils and sands free from marl appear to have the highest purifying qualities. Limestone formations, marls, clays, etc., are inferior in these properties. The longer a soil has been purifying sewer water, the fitter it becomes for continuing the work; for purifying irrigation multiplies the colonies of mineralizing ferments in the soil. Comparative examination of land in which the operation had been going on from ten to twenty years and of soil that was virgin to the process, showed that no nitrogen had accumulated in the earth in consequence of sewage irrigation. The smaller part of the mineralized matter passes into the crops, while the larger part is washed away.

Cycles and Dogs in War.—The utility of bicycles in military art having been demonstrated, men of war are now studying the means of contending against them and their riders. The mere overthrow of the instrument does not convey any great advantage, for the man is there, and possibly still standing, armed, and ready to fight. Dogs have so far seemed to be the most effective agents in this contention, and the large Danish dog has been selected as the animal most fit. About a thousand dogs are said to be under training in Berlin for this sort of warfare. They are taught to distinguish the uniforms of friends—German, Austrian, and Italian—from those of the enemy—French and Russian—and attack the latter, the legs of the sham "hostile" soldiers being well protected, of course, by stout buskins. As all the armies will have cycle troops, they will all have to have their trained war dogs; and then, when the attack has commenced, *La Nature* slyly intimates, and the dogs get mixed with the cyclists, they will leave the soldiers and go to fighting one another.

Hydraulic Blasting.—A meeting of the Manchester Geological Society is reported in Industries and Iron, at which a new hydraulic apparatus for breaking down coal in mines was discussed. Mr. James Tonge, who described the apparatus, called attention to the great danger attending the ordinary method of blasting in coal mines, and said that the numerous serious accidents from this cause had led the inventors to look for a safer process of loosening the coal. The new apparatus consists of a hydraulic cartridge, eighteen inches in length and three in diameter, and weighing thirty pounds, and a small but powerful hand pump fitted with a pressure gauge weighing about twenty pounds. The mode of using it is as follows: The coal is holed underneath the usual depth, and a hole drilled near the roof to about the same depth as the holing, in the same way as for blasting. After this the cartridge is placed in the hole and pushed to the back. No "stemming" is required. The pump is coupled to the cartridge, the suction pipe placed in a small bottle of water, and work commences. Very soon the gauge begins to show the rising pressure—half a ton, a ton, a ton and a half, two tons to the square inch. During this time a cracking sound is heard, indicating the shearing off of the coal at the back. The gradual way in which the work is done, without shock or jar of any kind, prevents even the least damage to coal or roof, in striking contrast to the action of explosives. The time occupied is an important matter. It has so far been about twelve minutes. This time includes placing the cartridge in the hole, connecting to the pump, getting down the coal, withdrawing the cartridge from the hole, and getting to the next place. The advantages claimed for this process over the ordinary blasting are (1) larger and stronger coal, which means a better average price; (2) non-interference with the working of the pit, the coal being got down whenever required; (3) no damage to roof; (4) no dust; (5) and absolute safety from the dangers attending shot firing. In previous machines of this sort trouble has been had with the joints, but it is stated that this one is free from that fault.

Timbuctoo and Jene.—Mysterious and romantic visions of wealth and gayety have been associated for centuries with the name of Timbuctoo. Of numerous travelers who have ventured much to reach the city only a few have succeeded. Thus, according to a summary in the London Academy, Mungo Park visited it in 1805, but was drowned in the Niger shortly afterward. Major Laing reached it in 1825, after a three years' expedition across the desert, but was murdered on leaving it. René Caillié found it about the same time, and wrote a book about it. Davidson was murdered, and Richardson died in the desert on the way thither. Dr. Bart found his way into the city, but never stirred out of doors while there. Lenz visited it and wrote a description of his adventure. The late Joseph Thomson was planning a visit to Timbuctoo when he died. Now the Frenchman, Félix Dubois, has published one of the best descriptions we have of the mysterious city. Its position on the edge of the Desert of Sahara, and at the top of the great bend of one of the largest and most constantly navigable rivers of the earth, the Niger, defines its importance. Yet M. Dubois found it not the greatest or most interesting town in the region. It is surpassed by Jene, whose name is echoed in the Anglicised form Guinea. That city dates from the seventh century; was built, not by negroes or negroids, but by the Songhis, who migrated from Egypt across the Soudan more than twelve hundred years ago; and has wonderfully solid architecture of the Egyptian order. The present inhabitants of Jene, M. Dubois says, "resemble a palimpsest on which the first manuscript is dimly decipherable. Their oral traditions, their chronicles, and their dwellings all betray their Nilotic fatherland."

Three Masters in Science.—We merely mentioned, last month, the deaths of Prof. Julius Sachs, the botanist, and Prof. Carl R. Fresenius, the chemist. Prof. Sachs was best known by his Text-book of Botany, which is one of the standard works of the science, of first authority. He was also author of the *Experimental Physiologie*, a work of corresponding importance in its field, a history of botany, and a collection of lectures. He was born at Breslau, Germany, in 1832, and died at Wurzburg, May 29th. His first teacher was Purkinje. He taught at Prague, Marandt, Chemnitz, and Poppelsdorf, near Bonn, and was Professor of Botany at Freiburg and Wurzburg. The fame of Fresenius dates from so early a period in the century that one would be almost inclined to reckon him as of a past generation. He was born at Frankfort-on-the-Main in 1818, began the study of natural science very early, entered the University of Bonn in 1840 and that of Giessen a year later, and became Professor of Chemistry, Physics, and Technology at the Agricultural Institute in Wiesbaden in 1845. He was identified with that institution for the rest of his life. His best-known works are the Qualitative Analysis and the Quantitative Analysis, published in 1841 and 1846 respectively, which have passed through very numerous editions and have been translated into nearly every European language. M. Paul Schutzenberger, an eminent French chemist, died June 26th, at Mézy, France. He was born at Strasburg, the son of a lawyer, in 1829; studied medicine and then chemistry; was made professor of chemistry in the high scientific school at Mulhouse; then became adjunct director of the chemical laboratory of the Sorbonne and chief of chemical work in the Collége de France. In 1876 he was named titular professor of chemistry in this institution. For many years he directed the physical and chemical school of the city of Paris. He was a member of the Academy of Medicine and the Academy of Sciences. His principal works were on the application of chemistry to animal physiology, coloring substances, fermentation (in the International Scientific Series), and the *Traité de Chimie Générale*, in seven volumes.

Primitive Drills.—We all know how difficult it is, even with the best tools we have, to bore a correct hole by hand in a hard substance. Vastly more difficult must this have been with primitive men, who had no tools except flints and bones and sticks. Yet, as Mr. J. D. McGuire observes in his study of the Primitive Methods of Drilling, the earliest remains of man are found associated with implements of his manufacture in which holes have been artificially perforated, the implements consisting generally of bone, ivory, or shell. During the cave period man had the implements called "batons of command," the use of which is unknown, which were bored with extreme care from reindeer horn, and are often carved with representations of animals or of man, often artistically done. These men could only fashion the rudest implements from chipped stone. At later periods of development beads of shell and stone were made of shapely forms and evenly perforated. Of such are the Indian wampum beads, which, according to Lawson's History of North Carolina, they managed "with a nail stuck in a cane or reed. Thus they roll it continually on their thighs with their right hand, holding the bit of shell with their left, so in time they drill a hole quite through it, which is a very tedious work." This describes the most primitive form of drill, except that men had not yet advanced to the nail. They used flints or bones or sticks, re-enforced with sand. Mr. McGuire's presentation of objects perforated with this sort of drill exhibits some specimens of fine work done in hard stone and applied to various purposes. The next development is the strap drill, in which a string or cord is wound around the stick, and when pulled back and forth produces corresponding alternations in the motions of the drill, and adds considerably to its power. To this was added a bow, the pulling and relaxing of which maintained the revolution of the instrument. An improvement on this was a disk, the momentum of which carried on the motion of revolution, and rewound in an opposite direction the string which had been unwound. When the bow was arranged so as to have an upward and downward motion on the stick, the pump drill was constituted, an instrument differing essentially from all other boring tools, relatively easy to work, which has been widely distributed. The Egyptian monuments bear frequent representations of the use of the bow and disk drills under different forms and with various modifications. The Egyptians, however, had copper and iron.

Birds and their Songs.—Whether birds inherit their song or learn it by imitation has been the subject of experiments which M. Flamel describes in *La Nature*. We know already that some species take up the songs of others, but it had not been determined whether they ever learned them at the expense of their native song. One of M. Flamel's correspondents had a sparrow, "brought up by hand," which, when put into a cage with finches and canary birds, took up the songs of all its companions, repeating them perfectly; and then, some captured crickets having been placed near it, adopted their chirp too, but never sang like a sparrow. Another correspondent was told by a gamekeeper of two linnets which he had taken from the nest when they were very young and kept at his home in a wood where there were no other birds of their species, but nightingales were abundant. The birds sang like nightingales. Of the somewhat varied repertory of songs of a certain species of linnet, this correspondent asserts that the songs are severally peculiar to certain well-defined localities. All the individuals in one of these districts have the same songs and the same number of songs, so that the fanciers in the city where he lives are acquainted with the songs of the several stations around and know just where to go to get birds to their liking. It follows from this that some birds, at least, learn their songs by imitation.

Sunlight and Bacteria in Rivers.—In view of the destructive effect of sunlight, especially of the blue to the ultra-violet rays, upon bacteria in water, Prof. H. Marshall Ward would explain the comparative freedom of river waters under the blazing hot summer sun from bacteria as against the more abundant infection of the same waters in winter. Pasteur and Miquel found that the germs floating in the air are for the most part dead—killed, the author holds, like the germs in the air of the Alps, by the sun. Yeasts which normally vegetate on the exterior of ripening grapes are destroyed, according to Martinaud, if the heat be very intense; and Giunti has observed that the ingress of sunlight hinders acetic fermentation—a bacterial process. So the access of light appears to be inimical to the germination and develment of fungi of various kinds. The destructive rays may be cut off by color screens, and the protected germs can then sprout and develop as easily as if no light was playing upon them. Such color screens appear to the author to be common in Nature, where the spores and tender growing cells are compelled to begin their vegetative processes in the light. The green chlorophyll screen of ordinary plants may fulfill this purpose. When the typhoid bacillus falls into turbid, dirty water in summer, it finds a congenial propagating place. The dirt furnishes it food, absorbs heat to increase the warmth, and keeps off the hostile blue and violet rays.

The Appraisal of Books.—The subject of furnishing librarians and the public with some general, comprehensive guide to the character and real value of books is discussed by Mr. George Iles in a paper on The Appraisal of Literature, which he presented to the International Library Conference held in London in July. The task of selecting from the enormous mass of books now appearing daily to be bought or read is a bewildering one. How make it easier? Mr. Iles would reach the end by a system of shortened reviews, prepared and adjusted for the purpose—"a brief note of description, criticism, and comparison, written by an acknowledged authority, signed and dated, and placed where the reader can not help seeing it, both within the lid of the reviewed book itself and on a card next the title-card in the catalogue." If the book treats of a question in debate, fact and opinion should be carefully distinguished, and views of opposed critics might be presented. By this means the inquirer would know which book is best, or among the best of its kind; would be made aware of defects; would learn how one book can gainfully piece out another; and would gather indications of the periodicals or transactions which bring a story of discovery and research down to date. In a final line he might be told where detailed reviews are to be found. Persons qualified to undertake this business of appraisal might be found among professional reviewers, who could "boil down" their larger reviews and adapt them. The work might be placed under the direction of a central superintendency of the American Library Association; and in connection with it something might be done "to rescue from neglect the great books which, from such causes as the untimely death of their authors, or the sheer brunt of advertisement, are overlaid by new and much inferior writing." Starts have been made toward this work in such manuals as the Reader's Guide in Economic, Social, and Political Literature, the List of Books for Girls and Women and their Clubs, and the special lists of books on fine art and on music.

Man's Language to Animals.—The exclamations we use in driving and calling horses, oxen, cats, dogs, fowls, and other domestic animals are presented by Prof. H. C. Bolton in a paper on the subject as affording familiar illustrations of a language of peculiar characteristics, whose words are chiefly monosyllabic and dissyllabic, and usually repeated in groups of three, utterly devoid of grammar, exclusively in the imperative mood, and consisting of words not found in the dictionaries, which serves as a ready and sufficient means of communication between man and the many races of animals under his subjection. It has little in common with the language used by the animals themselves, but is forced upon them by man and made comprehensible to them by constant repetition. The terms used are different in different countries. In thus controlling the actions of domestic animals by the voice, man makes comparatively little use of the language by which he communicates with his fellow-creatures, but employs a peculiar vocabulary, a variety of singular terms comprising inarticulate sounds and musical calls, whistling, chirping, clicking, and other sounds not easily represented by any combination of letters of the English alphabet, or by musical notation. Prof. Bolton has collected these words from a considerably large number of languages, ancient and modern, describes them, and analyzes them so far as they are susceptible of analysis. He reaches the general conclusion that the terms are mostly corruptions of the ancient names of the animals, sometimes with a prefix signifying "come," with expressions that have become otherwise obsolete. They are all subject to the same influences that lead to the development of dialects, and, the language being unwritten, the changes are quite radical. An important feature mentioned, but not dwelt upon at length, is the musical intonation giving a special character often associated with the call. We are surprised that while the author says much about "puss" as a call for the cat, he does not even mention "kitty," which is used a hundred times as often.

Plants and their Insect Inhabitants.—Plants have a special interest to the entomologist according to the number of insect species they harbor, and the invasion which causes dismay to the gardener brings him joy—qualified, we are glad to say, if the plant is a valuable one, by sorrow for his neighbor's trouble. Miss Mary E. Murtefeldt, of Kirkwood, Mo., has found no better way of making the acquaintance of the insect fauna of a locality than to take up, one after another, its native or introduced plants and, keeping them under close observation from spring till fall, and perhaps for several successive years, note the species that visit them and the larvæ that subsist upon them, either exclusively or in common with other plants. Many weeds afford abundant harvests of this kind; one of the most productive of them is the cut-leaved ragweed (*Ambrosia artemisiæfolia)* of roadsides and fallow fields, every part of which—foliage, flower, leafstalk, stem, and root—sustains its own peculiar species, the majority of which do not occur on other plants. This plant is especially a mine of wealth to the micro-lepidopterist in the number, beauty, and variety of the species that are partially or wholly dependent upon it. Miss Murtefeldt names between forty-five and fifty species of five orders which she has found on this one plant. Perhaps one fourth of these are limited to the genus *Ambrosia*, and six or seven have been found only on *artemisiæfolia.*

MINOR PARAGRAPHS.

It is reported that an important advance in color photography has been made by M. Villedieu Chassagne and Dr. Adrien Michel Dausac. The process is simple and inexpensive. A negative is taken on a gelatin plate, which has been treated with a solution of certain salts (the nature of the solution is kept secret). The negative is developed and fixed in the ordinary way. From it a positive is printed on a sensitized paper which has previously been treated with the unknown solution. This positive is then washed over with three colored solutions—blue, green, and red—and it takes up in succession the colors in their appropriate parts, and the combinations of the colors giving all varieties of tints.

Berthelot and Vieille have recently been experimenting with acetylene, in reference to its explosiveness. They found that when acetylene at ordinary pressure is exposed to the action of the electric spark, a red-hot wire, or a fulminate shock, the gas is decomposed only in the immediate vicinity; when the gas is under pressure, however, the result is quite different, the acetylene acting as do the ordinary explosive mixtures when the pressure exceeds two atmospheres—the explosion rapidly spreading through the entire mass which, decomposes into hydrogen and finely divided bulky carbon. Liquid acetylene behaves in the same way. Using eighteen grammes in a bomb of 48·96 c. c. capacity, the final pressure was 5,564 kilogrammes per square centimetres—almost the equal of gun cotton.

Stress is laid by M. Albert Gaudry, in his study of Philosophical Paleontology, on the increase of intelligence as a feature of animal development. First, there was progress in locomotion, and the sedentary invertebrates of Primary times were succeeded by the secondary reptiles, and they by the numerous Tertiary mammals. The continued improvement of the last was manifested in the gradual adaptation of the feet of the horse and deer, making them better fitted for speed. The power of sensation has also undergone a steady augmentation, and intelligence has been developed slowly and regularly. If, in the absence of other knowledge, we may judge concerning the nervous system of the invertebrates or of the Primary fishes from that of existing beings, we have to conclude that their intelligence was very imperfect. The forms of the brains of some of the Secondary reptiles, as revealed by molds of the interior of their skulls, show that they were very little advanced. By this criterion, the gigantic saurians were very stupid animals. A progressive development evidently took place during the Tertiary period. Finally, the brain of man, the latest, is the most complicated, the most voluminous, and at the same time the most condensed of all. The history of the world thus reveals to us a progress which has continued through the ages.

The utilization of burned clays as a road material is mentioned in Mr. C. B. Keyes's last Missouri Geological Report as a subject that should be fully discussed. Some of the railroads are already using burned clay for ballast in preference to rock, sand, or gravel, with good results, so that the extension of the use of this material to highways is in reality beyond the experimental stage. Prof. Wheeler says in his report on clays that, while it is not so good as tough rock for the heavy traffic in cities, it would prove durable for country roads, where the teams are few and the loads light. It can be prepared wherever the clay is, and often by the roadside; and as the heaviest roads are those in clay soils, these may be made themselves to furnish the material for their own improvement.

The failure of British girls' schools to achieve the results intended in scientific training was ascribed by Miss L. Edna Walter in the British Association to the two reasons that only the faculty of observation is, as a rule, cultivated, and that the work is not begun low enough down in the school. A gently graduated scientific course is, in the view of the author, wanted, beginning with the simplest experiments for young children, and gradually increasing in complexity till the girls reach the age of about sixteen. From beginning to end the course should be practical in character, and quantitative as far as possible. Such a course can be followed if practical arithmetic be made the starting point. This leads naturally to elementary physics, chiefly hydrostatics, and finally to a course of elementary chemistry. It is an important feature of the course suggested that the children should use no textbooks; their own notes written in their own language should form their books of reference. In this way their literary powers are cultivated; but, above all, they learn to rely upon themselves.

A remarkable discovery has been made near Perm of an extensive burial place of the supposed old inhabitants of Russia, the Chuds, from which exceedingly rich collections of implements have been recovered. Among them are at least a hundred earthenware vessels, and "cart loads" of broken pieces of earthenware ornamented with all sorts of figures illustrating the life of the people. Of these are men sitting on horseback and in small boats, nine engravings of bees and flies, fifty-nine engravings of birds, more than a hundred of different mammals, and ten of snakes. Three masks and one head of mammals were also found, a large silver plate representing a man standing on some animal, eight smaller silver pieces, a hundred and forty-one bronze plates, several bronze statuettes, and "an immense number" of rings, stars, bells, small models of sledges, thimbles, arrowheads, hatchets, knives, nearly four hundred gilded bronze pearls, fishing hooks, skulls of stags, various carnivorous animals, etc.

It is stated by Prof. T. F. Wright that recent exploration in Palestine clearly shows that all the ancient chronicles in regard to the wall of Jerusalem were trustworthy. It had a very strong wall, with frequent towers or bastions. The wall ran all around the brow of Zion Hill, crossing the Tyropæan

Valley, and then going northeasterly to the corner of the temple inclosure. As it will be represented on new maps, the present wall on the south side will be a nearly straight line, placed east and west, with a loop southward from its ends like a bow with cord loosened. The space between the straight and the curved lines has been very little explored as yet, but at the pool of Siloam Dr. Bliss has found the perfect formation of a very early Christian church, showing its whole plan. This place will be kept open, and will be one of the most interesting places in or near the city.

NOTES.

Some funeral jars found in Arkansas exhibit representations of the human face which contrast greatly with the crude figures usually characteristic of Indian and even of American art, they being accurate in anatomy and physiognomy. From a study of them Mr. F. S. Dellenbaugh concludes that they can be accounted for without supposing some exotic or wonderful native artist, by regarding them as death-masks made by taking a mold of the face and transferring it to the jar.

The effect of fasting upon the power of the system to resist infection from microbian toxines has been investigated by MM. J. Teissier and L. Guinard, and they find it a strengthening one. Animals which had been kept fasting bore out against inoculation much better than the control animals, and the resisting power seemed to increase with the length of the fast.

The Russian thistle, concerning the introduction and spread of which in the United States much alarm was expressed a few years ago, is likely, if we can credit the reports from the Western States, to prove a comparatively harmless pest, after all. It does not thrive so vigorously as it promised to, but rather declines after a year or two. In some districts the dried weed was chopped up fine and fed to cattle; and it has proved to be good fuel, and is even said to be marketable for that purpose.

Analyses of the air taken in the ascension of the "Aérophile," February 18, 1897, at the height of fifteen thousand five hundred metres, made by MM. Schloesing and A. Muntz, show that the composition of the air at that elevation, as has always been supposed, does not differ materially from that of the air of lower regions.

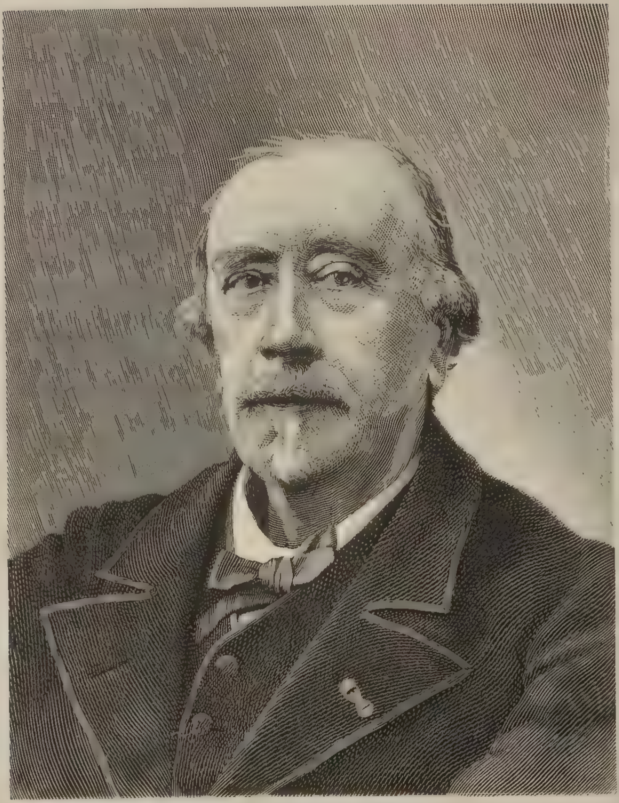
A very interesting question was brought up in the British Association, in the discussion of a paper by Mr. W. Barlow on homogeneous structures and the symmetrical partitioning of them with application to crystals. Lord Kelvin remarked on the immense number of possible methods of partitioning space, and said that, although Schucke was generally credited with having been the first to investigate the subject, it had been thoroughly worked out by Bravais, whose mind gave way under its overwhelming complexity. Prof. Miers said there were two hundred and thirty types of symmetry and only thirty-two types of crystal, so that the same crystal might contain several types of symmetry.

A railway is to be built up the Hochstauffen Mountain at Bad Reichenhall, Austrian Alps, of which it is contemplated that a balloon shall be the propelling power. The balloon will run along a track, consisting of a peculiarly shaped rail. This is clasped by a trailer, furnished with many wheels, to which a passenger car is fastened. The operator has a seat in the car, and a cord swings between his place and the balloon, by which the gas supply is regulated; and provision is given under his control of brakes and devices for safety against accident. The gas generator at the foot of the railroad will supply the town with illuminating gas, as well as furnishing that with which the balloon is filled.

Arterio-sclerosis is described by M. Huchard, in his treatise on Diseases of the Heart, as peculiarly the disease of physicians, politicians, and financiers, their liability to which is largely due to their practicing professions in which emotion is often intensified and which involve great liability to overwork. In addition, doctors have to experience unavoidable irregularities in hours, and sometimes continuous periods of work without rest. The single means of arresting and avoiding these consequences is by a diminution of anxiety and an avoidance of overwork, with measures taken as far as possible for repair of the wasted tissues.

Dr. Alfred Marshall Mayer died July 13th, after a protracted illness, in the sixty-second year of his age, at Maplewood, N. J. He had been Professor of Physics and Chemistry in the University of Maryland and in Westminster College, Missouri; Professor of Physics in Pennsylvania College, Gettysburg; Professor of Physics and Astronomy at Lehigh University; and, since 1871, Professor of Physics at Stevens Institute of Technology at Hoboken, N. J. In 1869 he had charge of one of the official parties sent out to observe the total eclipse. He was a member of seven scientific societies.

Fritz Müller, who died May 21st at Blumenau, Brazil, was best known by his book *Für Darwin*, enumerating facts in support of the Darwinian doctrine of the origin of species, which was translated into English. Darwin received also direct assistance from him in his investigations. He was the author of numerous memoirs on mimetism, coloration, etc.



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POPULAR SCIENCE
MONTHLY.

OCTOBER, 1897.

THE RACIAL GEOGRAPHY OF EUROPE.

A SOCIOLOGICAL STUDY.

(*Lowell Institute Lectures, 1896.*)

By WILLIAM Z. RIPLEY, Ph. D.,
ASSISTANT PROFESSOR OF SOCIOLOGY, MASSACHUSETTS INSTITUTE OF TECHNOLOGY; LECTURER IN ANTHROPO-GEOGRAPHY AT COLUMBIA UNIVERSITY.

IX.—ITALY.

THE anthropology of Italy has a very pertinent interest for the historian, especially in so far as it throws light upon the confusing statements of the ancients. Pure natural science, the morphology of the genus *Homo*, is now prepared to render important service in the interpretation of the body of historical materials which has long been accumulating. Happily, the Italian Government has assisted in the good work, with the result that our data for that country are extremely rich and authentic.* The anthropological problems presented are not as complicated as in France, for a reason we have already noted—namely, that in Italy, lying as it does entirely south of the great Alpine chain, we have to do practically with two instead of all three of the European racial types. In other words, the northern Teutonic blond race is debarred by the Alps. It does appear in a few places, as we shall take occasion to point out, but its influence is comparatively small. This leaves us, therefore, with two rivals for supremacy—viz., the broad-headed Alpine type of central Europe and the true Mediterranean race in the south.

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* The best authority upon the living population is Dr. Ridolfo Livi, Capitano Medico in the Ministero della Guerra at Rome. To him I am personally indebted for invaluable assistance. His admirable Antropometria Militare, Rome, 1896, with its superb atlas, must long stand as a model for other investigators. Titles of his other scattered monographs will be found in the author's Bibliography of the Ethnology of Europe, shortly to appear in a Bulletin of the Boston Public Library. Among other references of especial value on

A second reason, no less potent than the first, for the simplicity of the ethnic problems presented in Italy is, of course, its peninsulated structure. All the outlying parts of Europe enjoy a similar isolation. The population of Spain is even more unified than the Italian. The former is probably the most homogeneous in Europe, being almost entirely recruited from the Mediterranean long-headed stock. So entirely similar, in fact, are all the peoples which have invaded or, we had better say, populated the Iberian Peninsula that we are unable to distinguish them anthropologically one from another. The Spaniards are akin to the Berbers in Morocco, Algiers, and Tunis. The division line of races falls at the French-Spanish frontier, as the maps in our last article on the Basques showed in detail. "Beyond the Pyrenees begins Africa" indeed. In Italy a corresponding transition from Europe to Africa takes place, more gradually perhaps but no less surely. It divides the Italian nation into two equal parts, of entirely different racial descent.

Geographically, Italy is constituted of two distinct parts. The basin of the Po, between the Apennines and the Alps, is one of the best defined areas of characterization in Europe. The only place in all the periphery where its boundary is indistinct is on the southeast, from Bologna to Pesaro. Here, for a short distance, one of the little rivers which comes to the sea by Rimini, just north of Pesaro, is the artificial boundary. It was the Rubicon of the ancients, the frontier chosen by the Emperor Augustus between Italy proper and cisalpine Gaul. The second half of the kingdom, no less definitely characterized, lies south of this line in the peninsular portion. Here is where the true Italian language in purity begins, in contradistinction to the Gallo-Italian in the north, as Biondelli long ago proved. The boundaries of this half are clearly marked on the north along the crest of the Apennines, away across to the frontier of France; for the modern provinces of Liguria (see map) belong in flora and fauna, and, as we shall show, in the character of their population, to the southern half

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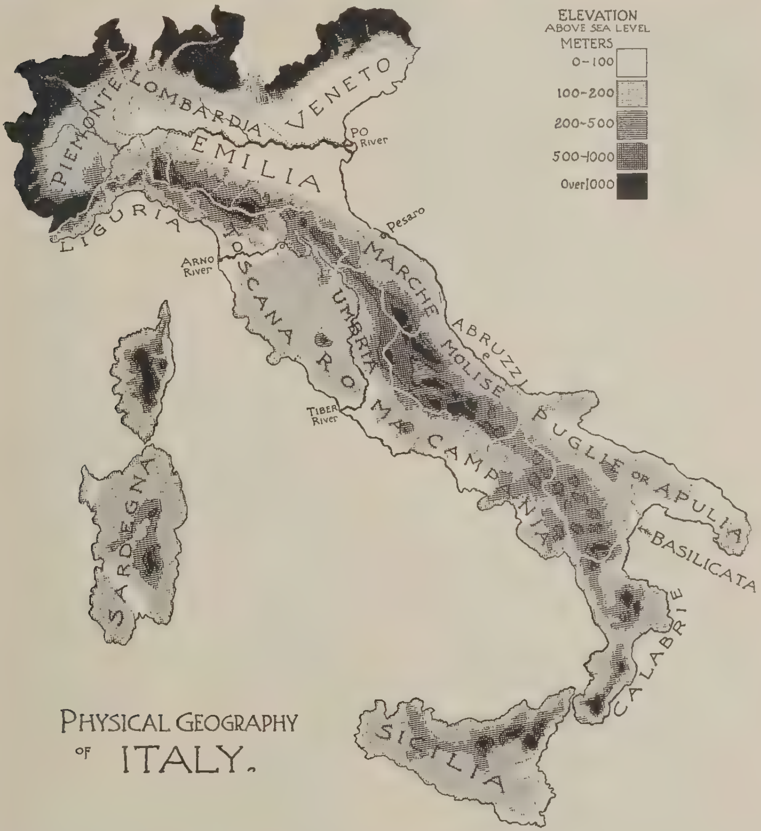
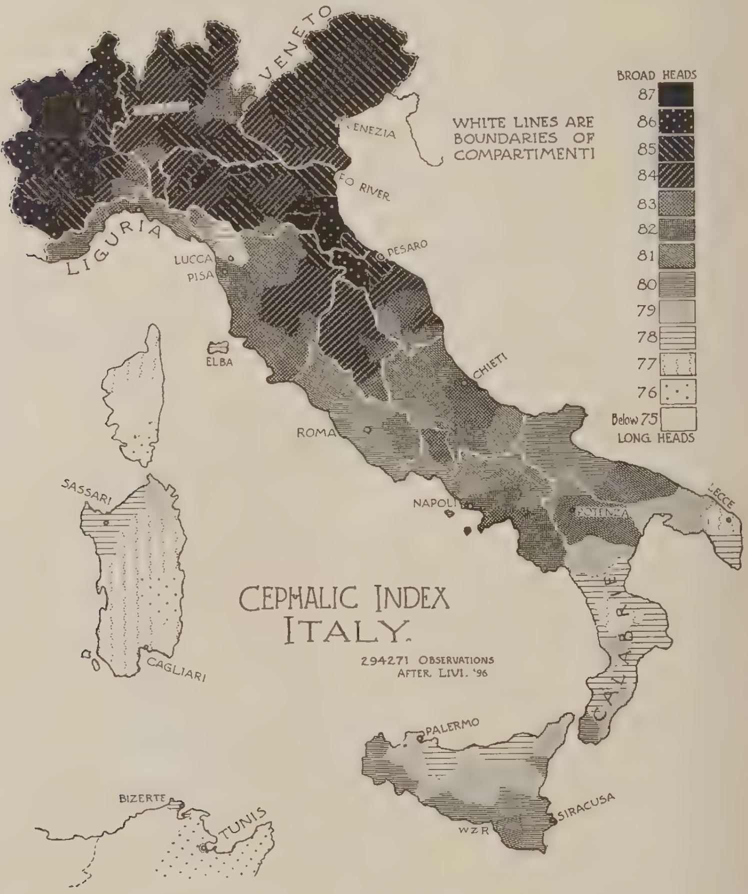
Italy are: G. Nicolucci, Antropologia dell' Italia nel evo antico e nel moderno, in Atti del R. Accademia delle Scienze di Napoli, series 2 a, ii, 1888, No. 9, pp. 1–112; G. Sergi, Liguri e Celti nella valle del Po, in Archivio per l'Antropologia, xiii, 1883, pp. 117–175, gives a succinct account of the several strata of population; R. Zampa, Sull' etnografia storica ed antropologica dell' Italia, Atti del Accademia pontificia dei Nuovi Lincei, Rome, xliv, session May 17, 1891, pp. 173 *seq.*; and ibid., Crania Italica vetera, Memorie Accad. pont. dei Nuovi Lincei, vii, 1891, pp. 1–73. Full references to the other works of these authors, as well as of Calori, Lombroso, Helbig, Fligier, Virchow, *et als.*, will be found in the author's bibliography above mentioned. Broca, in reviewing Nicolucci's work in Revue d'Anthropologie, 1874, gives a good summary of conclusions at that time, before the more recent methods of research were adopted.

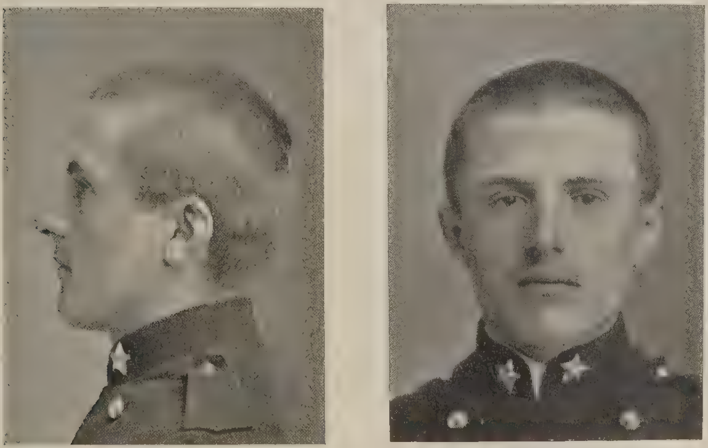
of the country. It is this leg of the peninsula which alone was called Italy by the ancient geographers: or, to be more precise, merely the portion south of Rome. Only by slow degrees was the term extended to cover the basin of the Po. The present political unity of all Italy, real though it be, is of course only a recent and, in a sense, an artificial product. It should not obscure our vision as to the ethnic realities of the case.


PHYSICAL GEOGRAPHY OF ITALY.

The topography and location of these two halves of the kingdom of Italy which we have outlined have been of profound significance for their human history. In the main distinct politically, the ethnic fate of their several populations has been widely different. In the Po Valley, the "cockpit of Europe," as Freeman termed it, every influence has been directed toward intermixture. Inviting in the extreme, especially as compared with the transalpine countries, it has been incessantly invaded from three points of the compass. The peninsula, on the other hand, has been much freer from ethnic interference, especially in the early days when navigation across seas was a hazardous proceeding. Only in the extreme south do we have occasion to note racial invasions along the coast. The absence of protected waters and especially of good harbors, all along the middle portion of the peninsula has not invited a landing from foreigners. Open water ways have not enabled them to press far inland, even if they disembarked. These simple geographical facts explain much in the anthropological sense. They meant little after the full development of water transportation, because thereafter travel by sea was far simpler than by land. Our vision must, however, pierce the obscurity of early times before the great human invention of navigation had been perfected.



In order to give a summary view of the physical characteristics of the present population which constitutes the two halves of Italy above described, we have reproduced upon the following pages the three most important maps in Livi's great atlas. Based as they are upon detailed measurements made upon nearly three hundred thousand conscripts, they can not fail to inspire confidence in the evidence they have to present. Especially is this true since their testimony is a perfect corroboration of the scattered researches of many observers since the classical work of Calori and Nicolucci thirty years ago. Researches at that time made upon crania collected from the cemeteries and crypts began to indicate a profound difference in head form between the populations of north and south. Then later, when Zampa, Lombroso, Pagliani, and Riccardi * took up the study of the living peoples, they revealed equally radical differences in the pigmentation and stature. It remained for Livi to present these new data, uniformly collected from every commune in the kingdom, to set all possible doubts at rest. It should be observed that our maps are all uniformly divided by white boundary lines into *compartimenti*, so called. These administrative districts correspond to the ancient historical divisions of the kingdom. Their names are all given upon our preceding map of physical geography. Being similar through the whole series, they facilitate comparisons between smaller districts in detail.



Alpine Type. Piedmont. Cephalic Index, 91·3.

The basin of the Po is peopled by an ethnic type which is manifestly broad-headed. This Alpine racial characteristic is intensified all along the northern frontier. In proportion as one penetrates the mountains this phenomenon becomes more marked. It culminates in Piedmont along the frontier of France. Here, as we have already shown in our general map of Europe, is the purest representation of the Alpine race on the continent. Dr. Livi has photographed a recruit from this region for me. It is reproduced upon this page. The rounded fullness at the forehead and the shortness of head from front to back can not fail of notice. Across the frontier, in French Savoy, the same racial type is firmly intrenched in the high Alps. Such is also the prevalent physical type of the Swiss, who are descendants of the Rhætians of Roman times. Still further back we come upon the prehistoric lake dwellers. No change of race has here taken place since very early times. All indications point to a primitive occupation and a persistent defense of the Alpine highland by this broad-headed racial type.*

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* Exhaustive bibliography of each of these writers will be found in the Bulletin of the Boston Public Library, mentioned in the note on a preceding page.

This Alpine type in northern Italy is the most blond and the tallest in the kingdom. This, of course, does not imply that these are really a blond and tall people. Compared with those of our own parentage in northern Europe, these Italians appear to be quite brunette; hair and eyes in our portrait type were classed as light chestnut. Standing in a normal company of Piedmontese, an Englishman could look straight across over their heads; for they average three to five inches less in bodily stature than we in England or America; yet, for Italy, they are certainly one of its tallest types. The traits we have mentioned disappear in exact proportion to the accessibility of the population to intermixture. The whole immediate valley of the Po, therefore, shows a distinct attenuation of each detail. We may in general distinguish such ethnic intermixture from either of two directions: from the north it has come by the influx of Teutonic tribes across the mountain passes; from the south, by several channels of communication across or around the Apennines from the peninsula. For example, the transition from Alpine broad heads in Emilia to the longer-headed population over in Tuscany near Florence is rather sharp, because the mountains here are quite high and impassable, save at a few points. On the east, however, by Pesaro, where natural barriers fail, the northern element has penetrated farther to the south. It has overflowed into Umbria, Tuscany, and Marche, being there once more in possession of a congenial mountainous habitat.* The same geographical isolation which, as Symonds asserts, fostered the pietism of Assisi, has enabled this northern type to hold its own against aggression from the south.

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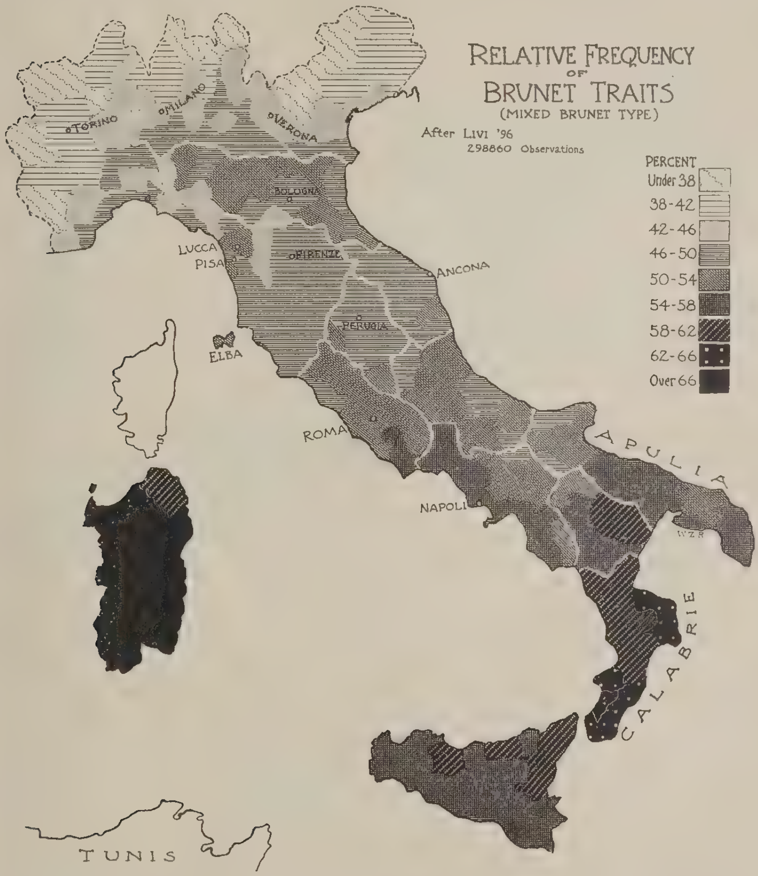
* Whether this brachycephalic population is to be identified historically with the "Ligurians" or not is still matter of earnest dispute. Nicolucci, Calori, and most foreign authorities answer it affirmatively. On the other hand, such eminent specialists as Livi, Sergi, and Zampa agree in tracing the Ligurians back to a still more primitive and underlying stratum of population. This original stock was dolichocephalic, identical with the Mediterranean type in the south. Its direct descendants and survivors are the people of the modern province of Liguria, to be described shortly. These latter writers hold the broad-headed more recent overlying people to be the true Celtic invaders from the Alps. Whichever theory be correct, we may rest assured of the ethnic facts in the case. There is no longer doubt of the two distinct strata. To christen them is a relatively unimportant matter, from our point of view.



It is rather interesting to note the prevalence of the brachycephalic Alpine race in this mountainous part of Italy; for nowhere else in the peninsula proper is there any evidence of that differentiation of the populations of the plains from those of the mountains which we have noted in other parts of Europe. Nor is a reason for the general absence of the phenomenon hard to find. If it be, indeed, an economic and social phenomenon, dependent upon differences in the economic possibilities of any given areas, there is little reason for its appearance elsewhere in Italy; for the Apennines do not form regions of economic unattractiveness, as their geology is favorable to agriculture, and their soil and climate are kind. In many places they are even more favorable habitats than the plains, by reason of a more plentiful rainfall. The absence of anthropological contrasts coincident with a similar absence of economic differences is, in fact, a point in favor of our hypothesis.

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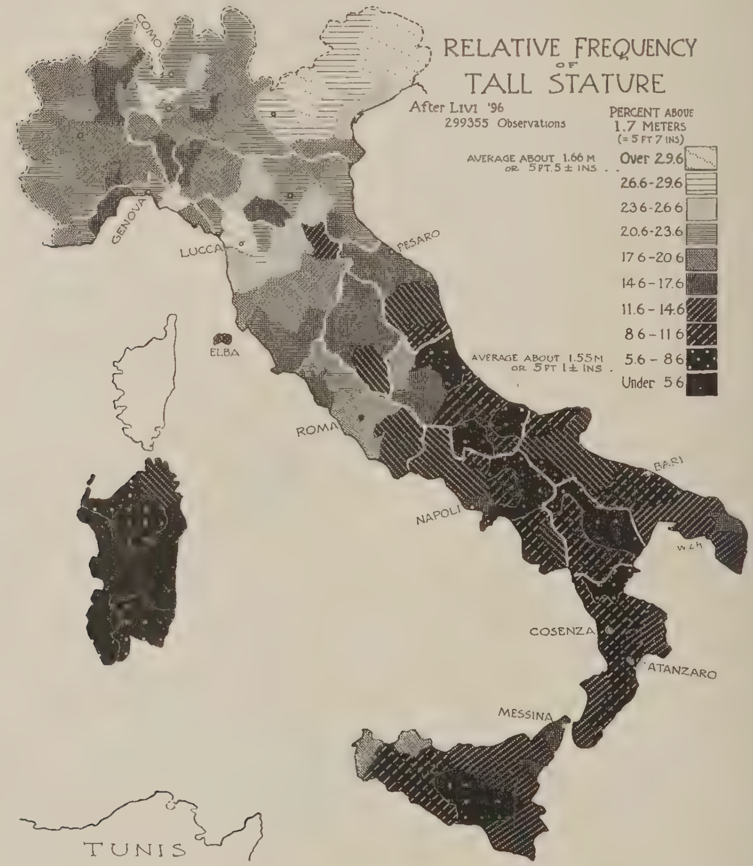
* *Vide*, on the Umbrians, Zampa, in Archivio per l'Antropologia, xviii, 1888, pp. 175 *et seq.*; and Memorie Accademia pontificia dei Nuovi Lincei, Rome, 1889, pp. 111 *et seq.*



Are there any vestiges in the population of northern Italy of that vast army of Teutonic invaders which all through the historic period and probably since a very early time has poured over the Alps and out into the rich valley of the Po? Where are those gigantic, tawny-haired barbarians described by the ancient writers who came from the far country north of the mountains? Even of late there have been many of them—Cimbri, Goths, Ostrogoths, Visigoths, Saxons, Lombards. Historians are inclined to overrate their numerical importance as an element in the present population. On the other hand many anthropologists, Virchow for example, have asserted that these barbarian invaders have completely disappeared from sight in the present population. Truth lies intermediate between the two. It is, of course, probable that ancient writers exaggerated the numbers in the immigrant hordes. Modern scholars estimate their numbers to be relatively small. Thus Zampa* holds the invasion of the Lombards to have been the most considerable numerically, although their forces did not probably exceed sixty thousand, followed perhaps by twenty thousand Saxons. Eighty thousand immigrants in the most thickly settled area in ancient Europe surely would not have diluted the population very greatly. We can not expect too much evidence in this direction consequently, although there certainly is some. The relative purity of the Piedmont Alpine type compared with that of Veneto is probably to be ascribed to its greater inaccessibility to these Teutons. Wherever any of the historic passes debouch upon the plain of the Po there we find some disturbance of the normal relations of physical traits one to another; as, for example, at Como, near Verona, and at the mouth of the Brenner in Veneto. The clearest indubitable case of Teutonic intermixture is in the population of Lombardy about Milan. Here, it will be observed on our maps, is a distinct increase of stature; the people are at the same time relatively blond. The extreme broad-headedness of Piedmont and Veneto is moderated. Everything points to an appreciable Teutonic blond. This is as it should be. Every invading host would naturally gravitate toward Milan. It is at the focus of all roads over the mountains. Ratzel, in his Anthropo-Geographie, has contrasted the influence exerted by the trend of the valleys on the different slopes of the Alps. Whereas in France they all diverge, spraying the invaders upon the quiescent population; in Italy all streams seem to concentrate upon Lombardy.† The ethnic consequences are apparent there, perhaps for this reason.

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* Les Gaulois d'Italie, in Mem. pont. Accad. di Nuovi Lincei, Rome, viii, 1892, pp. 241–316.

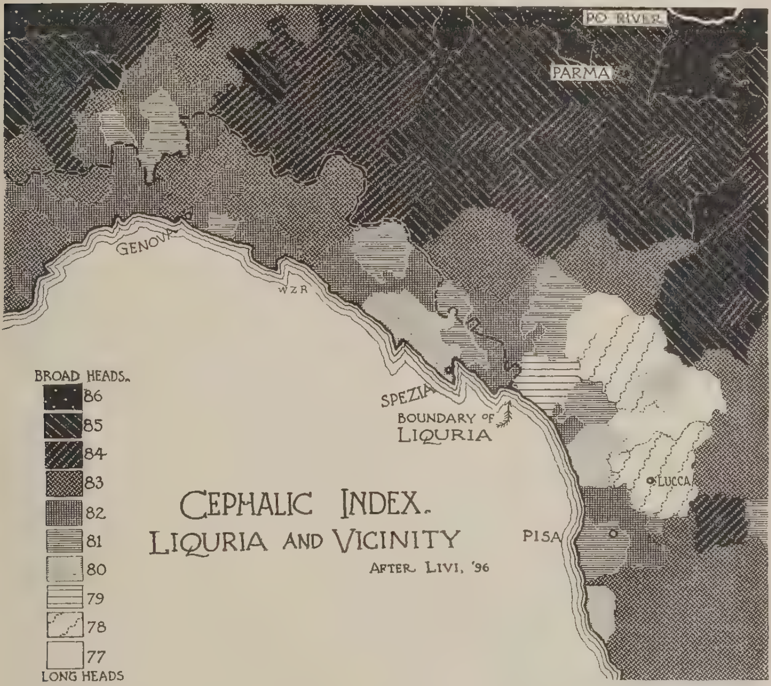
† On the significance of the Alpine passes, *vide* Lentheric, Les Alpes devant l'Homme; also Jahresbericht des Vereins für Erdkunde zu Dresden, xviii.

With the exception of Lombardy the blood of the Teutonic invaders in Italy seems to have been diluted to extinction. Notwithstanding this, it is curious to note that the German language still survives in a number of isolated communities in the back waters of the streams of immigration. Up in the side valleys along the main highways over the Alps are still to be found German customs and folklore as well. The peasants, however, are not to be distinguished physically at this present day from their true Italian-speaking neighbors. These southern Alps are also places of refuge for many other curious *membra disjecta*. Mendini, for example, has studied in Piedmont, with some detail, a little community of the Valdesi, descendants of the followers of Juan Valdès, the mediæval reformer. Here they have persisted in their heretical beliefs despite five hundred years of persecution and ostracism. In this case mutual repulsion seems to have produced real physical results, as the people of these villages seem to differ quite appreciably from the Catholic population in many important respects.

The ethnic transition from the Alpine race in the Po Valley to the Mediterranean race in Italy proper is particularly sharp along the crest of the Apennines from the French frontier to Florence. The population of modern Liguria, the long, narrow strip of country between the mountains and the Gulf of Genoa, is distinctly allied to the south in all respects. Especially does the Mediterranean long-headedness of this region appear upon both of our maps of cephalic index. It is curious to note how the sharpness of the ethnic boundary is softened where the physical barriers against intercourse between north and south are modified. Thus there is just north of Genoa a decided break in the distinct racial frontier of the province; for just here is, as our topographical map of the country indicates, a broad opening in the mountains leading over to the north. The pass is easily traversed by rail to-day. Over it many invasions in either direction have served to confound the populations upon either side.

The individuality of the modern Ligurians culminates in one of the most puzzling ethnic patches in Italy, viz., the people of the district about Lucca, in the northwest corner of Tuscany. Consideration of our maps will show the strong relief with which these people stand forth from their neighbors. These peasants of Garfagnana and Lucchese seem to set all ethnic probabilities at naught. They are as tall as the Venetians or any of the northern populations of Italy, yet in head form they are closely allied to the people of the extreme south. They are among the longest-headed in all the kingdom. They seem also to be considerably more brunette than any of their neighbors. Nor are these peculiarities of modern origin; certainly not their stature, at all events. For Strabo tells us that the Romans were accustomed to recruit their legions here because of the massive physique of the people.

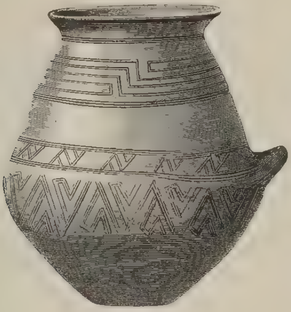
In order to make the reality of this curious patch more apparent, we have reproduced in our small map on this page a bit of the country in detail. It shows how suddenly the head form changes at the crest of the Apennines as we pass from the Po valley to the coast strip of Liguria. As we leave the river and rise slowly across Emilia toward the mountain range the heads gradually become less purely Alpine: and then suddenly as we cross the watershed we step into an entirely different population. On the southern edge this little spot of Mediterranean longheadedness terminates with almost equal sharpness, although geographical features remain quite uniform. This eliminates environment as an explanation for the phenomenon; we must seek the cause elsewhere.



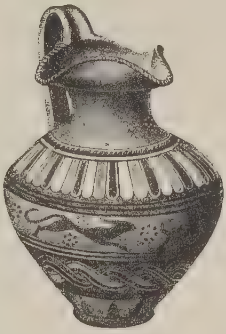
All sorts of explanations for the peculiarities of this ethnic spot about Lucca have been presented. Lombroso, who first discovered its tall stature, inclines to the belief that here is a last relic of the ancient and long-extinct Etruscan people penned in between some of the highest mountains in Italy and the sea. He holds that they were here driven to cover in this corner of Tuscany by the developed Roman power in the south. Dr. Beddoe gives another explanation which is interesting. He believes this population to be the result of artificial colonization. Livy tells us that the Romans at one time, in pursuance of a long-settled policy, transported forty thousand Ligurians (?) to Samnium, filling their places with others from the south. If this artificial transplanting had been effected a sufficient number of times; if the Liguria of Livy had surely been this modern one instead of the Alpine ancient one; and thirdly, if we could thus account for the tallness of stature, certainly not of southern origin, we might place more reliance upon this ingenious hypothesis. As it is we can not think it far reaching enough. To us it seems more likely that we have to do rather with a population highly individualized by geographical isolation. Much of the region is very fertile; it is densely populated; it is closely bounded by mountain and sea. May it not contain a remnant of a more ancient people than others roundabout? This accords with both Sergi's and Livi's view. At a later time we shall be able to prove that in many respects the oldest, most primitive layer of population in Italy possessed many of these peculiar traits of the Garfagnanans and Luccheser. We incline to the belief that a bit of this primitive substratum has persisted in this place. The people of the island of Elba off the coast are quite similar to it. Insularity explains their peculiar physical traits. Why not environmental isolation about Lucca as well?

One of the most disputed points in the ethnological history of Europe concerns the origin of the ancient Etruscans, who dominated middle Italy a thousand years or more before the Christian era. Ancient Etruria covered what is now made up of the two compartimenti of Toscana and Roma—extending, that is to say, from the Arno to the Tiber. Here we find a sub-area of characterization, rich alike in soil and climate, somewhat isolated from the rest of the peninsula. This district is the center of one of the earliest highly evolved cultures in Europe. The Etruscans appear suddenly upon the scene, invading the territory of the Umbrians, who seem to have been indigenous to the soil, akin to the Oscians, Italians (Vituli), and other native peoples. With the advent of this immigrant people a great advance in culture seems to have occurred, from which Rome afterward derived her supremacy in that respect: for the Etruscans were the real founders of the Eternal City.

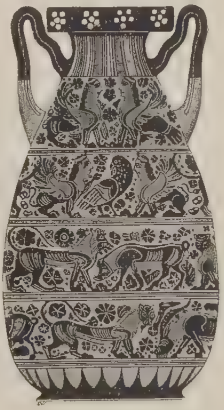
Popularly, the word "Etruscan" at once suggests the ceramic art; the progress effected in a short time was certainly startling. To give an idea of the sudden change, we have reproduced upon this page illustrations of typical bits of Italian pottery. The first vase, prior to the full Etruscan culture, shows its crudity at once, both in its defects of form and the plainness and simplicity of its ornamentation. Such a vessel might have been made in Mexico or even by our own Pueblo Indians. In a century or two some teacher made it possible to produce the sample depicted in the next cut. Perfect in form, superb in grace of outline, its decoration is most effective; yet it betrays greater skill in geometrical design than in the representation of animate life. The dog drawn on the girdle is still far from lifelike. Then come—probably after inspiration from Greek art—the possibilities in complex ornamentation represented by our third specimen. Not more pleasing in form; perhaps less truly artistic because of its ornateness, it manifests much skill in the delineation of human and animal forms. The culture culminates at this point. From profusion of ornament and overloaded decoration degeneracy begins. It is the old story of the life and decay of schools of art, time in and time out, the world over.



EARLY ETRUSCAN.



PURE ETRUSCAN.
Middle Period.



GREEK ETRUSCAN.

The advance in culture typified by our vases was equaled in all the details of life.* The people built strongly walled cities; they constructed roads and bridges; their architecture, true predecessor of the Roman, was unique and highly evolved. All the plain and good things of life were known to these people, and their civilization was rich in its luxury, its culture and art as well. In costumes, jewelry, the paraphernalia of war, in painting and statuary they were alike distinguished. Their mythology was very complex, much of the Roman being derived from it. Most of our knowledge of them is derived from the rich discoveries in their chambered tombs, scattered all over Italy from Rome to Bologna. There can be no doubt of a very high type of civilization attained as early as ten or twelve centuries before the Christian era. Roman history is merged in the obscurity of time, five or six hundred years later than this. The high antiquity of the Etruscan is therefore beyond question.

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* A good recent *résumé* of Etruscan culture is given by Lefevre in Revue Mensuelle de l'École d'Anthropologie, i, pp. 112 *seq.* and 268 *seq.*, and also in Revue Linguistique.

We know less of the language used by the Etruscans than of many other details of their existence—only enough to be assured that it was of an exceedingly primitive type. It was constructed upon as fundamentally different a system from the Aryan tongues as is the Basque, described in our last paper. It seems to have been, like the Basque, allied to the great family of languages which includes the Lapps, Finns, and Hungarians in modern Europe, and the aborigines of Asia and America. These unfortunate similarities led to all sorts of queer theories as to the racial origin of the people; as wild, many of them, as those invented for the Basques. It never occurred to any one to differentiate race, language, and culture one from another, distinct as each of the trio may be in our eyes to-day. If a philologist found similarity in linguistic structure to the Lapp, he immediately jumped to the conclusion that the Etruscans were Lapps, and Lapland the primitive seat of the civilization. Thus Taylor, in his early work, asserts an Asiatic origin akin to the Finns. Then Pauli and Deecke for a time independently traced them to the same Turanian source. At last, when the Etruscan civilization began to be investigated in detail, authorities fell into either one of two groups. They both agree that the culture itself was of foreign origin. The Germans, with the sole exception of Pauli * and Cuno, are unanimous in the assertion that it is an immigrant from the Danube Valley and northern Europe. These authorities regard it as an offshoot of the so-called Hallstadt civilization, which flourished at a very early period in this part of the continent. In a later paper on the Aryan culture we shall have occasion to speak of it more in detail. At the same time they declare the people racially to be of Rhætian or Alpine origin. The second school is disposed to derive the Etruscan civilization from the southeast—generally Lydia in Asia Minor. The relation of

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* Von Czoernig, Helbig, Hoernes, Hochstetter (for a time), Koch, Müllenhoff, Niebuhr, Mommsen, Seemann, Steub, and Virchow. Taylor, in later work, seems to agree. Complete titles will be found in the author's Bibliography of the Ethnology of Europe above mentioned.

the Etruscan to the Greek is by them held to be very close.* Much evidence is favorable to either side. To us it seems that Deecke is more nearly correct than either. He holds it to be probable that both centers of civilization contributed to the common product. In his opinion the Etruscans were crossed of the Tyrrhenians from Asia Minor and the Raseni from the Alps. All these views, it will be noted, concern civilization mainly. It is now time for us to examine the purely physical data at our disposition. Even supposing their culture to have been an immigrant from abroad, that need not imply a foreign ethnic derivation for the people themselves.

Inspection of our maps, in so far as they concern Etruria, convinces one that if the Etruscans were of entirely extra-Italian origin, their descendants have at the present time completely merged their identity in that of their neighbors; for no sudden transitions are anywhere apparent, either in respect of head form, stature, or pigmentation. On the whole, the trend of testimony appears to favor the German theory that the Etruscans made a descent upon Italy from the north; and that they were derived from the Rhætians, racial ancestors of the modern Swiss and other Alpine peoples. Thus it will be observed that Tuscany allies itself in head form to the north rather than the south. Especially is this brachycephaly noticeable about Bologna, just over the Apennines in Emilia. In this region, especially about Bologna, many of the richest archæological finds of Etruscan remains have been made. There appears to be a sort of wedge of broad-headedness penetrating the peninsula nearly as far south as Rome. This could not be if the Etruscans had been ethnically of Greek or Semitic origin; for the Greeks were and are of a type quite similar to the Italians of the extreme south—of Mediterranean racial descent, in fact. Certainly no ethnic type of this kind has contributed largely to make up the modern Tuscan people.†

To us it appears as if here, in the case of the Etruscans as of the Teutonic immigrants, we find reason to suspect that the ethnic importance of the invasion has been immensely overrated by historians and philologists. It seems quite probable that the Etruscan culture and language may have been determined by the decided impetus of a compact conquering class; and that the peasantry or lower orders of population remained quite undisturbed. It is certain that the remains of the people unearthed in their tombs betray very mixed characteristics. Crania are very rare, owing to the customs of cremation which were in vogue; such as have been studied are of all types.* It appears, from the few that have been measured, that a long-headed (Greek ?) element was rather predominant; and, as we have already observed, Lombroso and others are inclined to regard the peculiarly dolichocephalic people about Lucca as the last remnant of the pure Etruscan. If all Etruria were once like this, it must have changed wonderfully in the historic period, contrary to most of the experience we have related, for to-day this long-headed element is relatively quite scarce. For our own part, we regard the testimony of fifty thousand living peasants, more or less, as more credible than the evidence from a score or two of crania of uncertain origin, even though they be found in Etruscan tombs.

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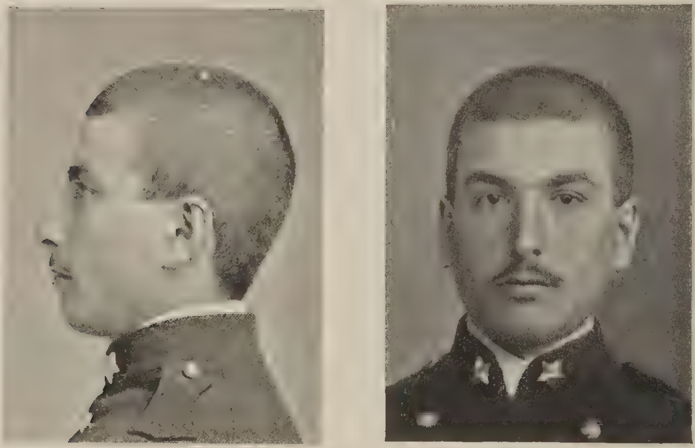
* The Italians range themselves on this side—viz., Brizio, Nicolucci, Lombroso, Sergi, and Zampa. With them stand Brinton, Evans, Lefevre, Montelius, and Myres, with Hochstetter in his later work.

† On the Greeks *vide* Zampa's Anthropologie Illyrienne, in Revue d'Anthropologie, series 3, i, pp. 632 *seq.*, and Weisbach in Mitt. Anth. Ges. in Wien, xi, pp. 72 *seq.*



Mixed Type. Island of Ischia. Cephalic Index, 83·6.

On the whole, we are inclined to the belief that our Etruscan ethnic origins must be sought in the north rather than in the south; in other words, that the Etruscans were an offshoot of our Alpine race of central Europe. Since the earliest times, as Zampa has proved, and it agrees with evidence from all around the Alps, there has been a steady outflow of population from this inhospitable habitat, unable as it is to afford sustenance to an increasing population. This downpour of broad-headed Alpine race types has entirely overcome the valley of the Po. In prehistoric times the people of Lombardy, Veneto, and Emilia were quite similar to the modern peasants in the extreme south. All Italy, in other words, was once Mediterranean in type. This has been proved.

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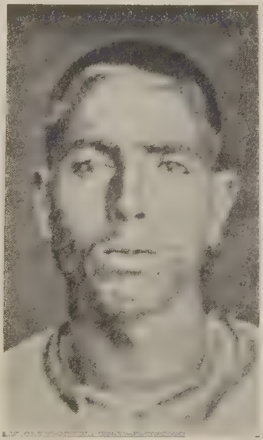
* The best references on this subject (see author's bibliography) are Zampa, 1891, pp. 48–56; Nicolucci, 1869, and especially 1888, pp. 12–52.

Is it not probable that the same flood of expanding population from the north which submerged these districts may have traversed the Apennines and overflowed both Etruria and Umbria? The so-called Etruscan historic invasion may have been merely an incident in this great demographic event. This internal origin for the Etruscan *race* is rendered all the more probable by other evidence close at hand. All the chief cities were well inland. None were on the coast, where Greek or Phœnician invaders by sea would most likely have located. The Etruscans, in fact, seem to have been quite ignorant of the art of navigation; and, finally, the testimony of place names points to the Alps as a point of initial dispersion, as Canon Taylor has shown.

Middle Italy south of Umbria has little of special interest to offer. It is merely intermediate between north and south. To make this transition clear, compare the portrait on preceding page with that of our pure Alpine type on page 725 and with the pure Mediterranean type on this page. Owing to the late Abyssinian war so many of the Calabrians and Sardinians in the south were in the field that it was impossible to procure photographs of these racial types. They are quite similar, however, in head form to those which prevail in Tunis. For all practical purposes this African will do as well. Notice that the breadth of forehead and the roundness of face in our medium type stand between the extremes on either side. In pigmentation and stature the same thing is true. Little by little as we go south the Alpine blonde is eliminated until we reach the Mediterranean race in all its purity.



Berber. Tunis.
Cephalic Index, 72.

The southern part of the Italian Peninsula is to-day the seat of a Mediterranean population of remarkably pure ethnic descent. The peasants are very long-headed, strongly brunette, and almost diminutive in stature. Especially is this true in the mountains of Calabria, where geographical isolation is at an extreme. Along the coasts we find little points of contact with invaders by sea. Apulia (see map of geography) especially contains many foreign colonies.* Some of these are of interest as coming from the extremely broad-headed country east of the Adriatic. So persistently have these

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* *Vide* for details Zampa's excellent Vergleichende anthropologische Ethnographie von Apulien in Zeitschrift für Ethnologie, 1886, pp. 167–193, and 201–232.

Albanians kept by themselves that after four centuries they are still characterized by a cephalic index higher by four units than the pure long-headed Italians about them. Many Greek colonists have settled along these same coasts. They, however, being of the same ethnic Mediterranean stock as the natives, are not physically distinguishable from them.

In conclusion, let us for a moment compare the two islands of Sicily and Sardinia in respect of their populations. With the latter we may rightly class Corsica, although it belongs to France politically. Our maps corroborate the historical evidence with surprising clearness. In the first place, the fertility and general climate of Sicily are in marked contrast to the volcanic, often unpropitious geological formations of the other islands. In respect of topography as well, the differences between the two are very great. Sardinia is as rugged as the Corsican nubble north of it. In accessibility and strategic importance Sicily is alike remarkable. Commanding both straits at the waist of the Mediterranean, it has been, as Freeman in his masterly description puts it, "the meeting place of the nations." Tempting therefore and accessible, this island has been incessantly overrun by invaders from all over Europe—Sicani, Siculi, Fenicii, Greeks and Romans, followed by Albanians, Vandals, Goths, Saracens, Normans, and at last by the French and Spaniards. Is it any wonder that its people are less pure in physical type than the Sardinians or even the Calabrians on the mainland nearby? Especially is this noticeable on its southern coasts, always more open to colonization than on the northern edge. Nor is it surprising, as Freeman rightly adds, that "for the very reason that Sicily has found dwelling places for so many nations a Sicilian nation there never has been."

Sardinia and Corsica, on the other hand, are two of the most primitive and isolated spots on the European map, for they are islands a little off the main line. Feudal institutions of the middle ages still prevail to a large extent. We are told that the old wooden plow of the Romans is still in common use to-day.* This geographical isolation is peculiarly marked in the interior and all along the eastern coasts, where almost no harbors are to be found. Here in Sardinia stature descends to the very lowest level in all Europe, almost in the world. Whether a result of unfavorable environment or not, this trait is very widespread to-day. It seems to have become truly hereditary. It extends over fertile and barren tracts alike. In other details also there is the greatest uni-

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*Bull. Soc. d'Anth., Paris, 1882, p. 310. On anthropology see work of Onnis, in Archivio per l'Antropologia, xxvi, 1896, pp. 27 *seq.*, besides the other authorities aforenamed.

formity all over the island—a uniformity at an extreme of human variation be it noted: for this population is entirely free from all intermixture with the Alpine race so prevalent in the north.

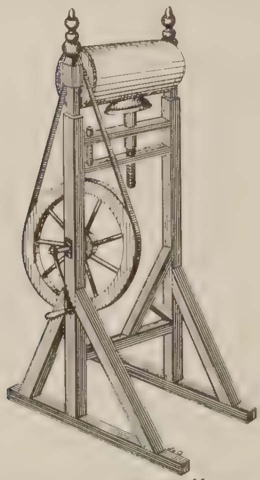
We have now seen how gradual is the transition from one half of Italy to the other. The surprising fact in it all is that there should be as much uniformity as our maps indicate. Despite all the overturns, the ups and downs of three thousand years of recorded history and an unknown age precedent to it, it is wonderful to observe how thoroughly all foreign ethnic elements have been melted down into the general population. The political unification of all Italy, the rapid extension of means of communication, and, above all, the growth of great city populations constantly recruited from the rural districts, will speedily blot out all remaining traces of local differences of origin. Not so with the profound contrasts between the extremes of north and south. These must ever stand as witness to differences of physical origin as wide apart as Asia is from Africa. This is a question which we defer to a subsequent article in our series, when we shall return specifically to trace the geographical origin of these great European elemental races each by itself.

FRANKLIN'S KITE EXPERIMENT WITH MODERN APPARATUS.

By ALEXANDER McADIE.

THE recent improvements in kites have suggested perhaps to many the question, "How would Franklin perform his kite experiment to-day?" It may seem a little presumptuous to speak for that unique philosopher, and attempt to outline the modifications he would introduce were he to walk on earth again and fly kites as of yore; for, with the exception of Jefferson, perhaps his was the most far-seeing and ingenious mind of a remarkable age. But the world moves; and in making kites, as well as in devising electrometers and apparatus for measuring the electricity of the air, great advances have been made. Franklin would enjoy repeating his kite experiment to-day, using modern apparatus. What changes and lines of investigation he would suggest are beyond conjecture.

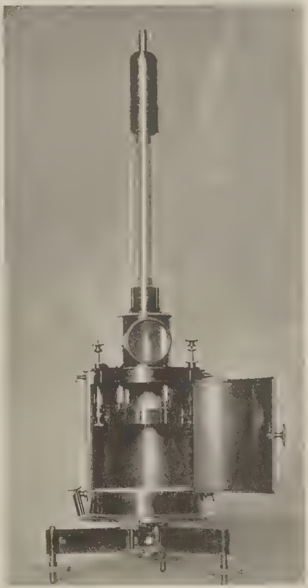
A hundred and fifty years ago a ragged colonial regiment drew up before the home of its philosopher-colonel and fired an ill-timed salute in his honor. A fragile electrical instrument was shaken from a shelf and shattered. Franklin doubtless appreciated the salute and regretted the accident. In the course of his long life he received other salutes, as when the French Academy rose at his entrance; and he constructed and worked with other electrometers; but for us that first experience will always possess a peculiar interest. The kite and the electrometer betray the intention of the colonial scientist to explore the free air, and, reaching out from earth, study air electrification *in situ*. He made the beginning by identifying the lightning flash with the electricity developed by the frictional machine of that time. A hundred patient philosophers have carried on the work, improving methods and apparatus, until to-day we stand upon the threshold of a great electrical survey of the atmosphere. It is no idle prophecy to say that the twentieth century will witness wonderful achievements in measuring the potential of the lightning flash, in demonstrating the nature of the aurora, and in utilizing the electrical energy of the cloud. The improved kite and air-runner will be the agency through which these results will be accomplished.


Franklin's Electrical Machine.

The famous kite experiment is described by Franklin in a letter dated October 19, 1752: "Make a small cross of light sticks of cedar, the arms so long as to reach to the four corners of a large, thin silk handkerchief when extended. Tie the corners of the handkerchief to the extremities of the cross, so you have the body of a kite which, being properly accommodated with a tail, loop, and string, will rise in the air like those made of paper, but being made of silk is better fitted to bear the wet and wind of a thunder gust without tearing. To the top of the upright stick of the cross is to be fixed a very sharp-pointed wire rising a foot or more above the wood. To the end of the twine next the hand is to be tied a silk ribbon, and where the silk and twine join a key may be fastened. This kite is to be raised when a thunder gust appears to be coming on, and the person who holds the string must stand within a door or window, or under some cover, so that the silk ribbon may not be wet; and care must be taken that the twine does not touch the frame of the door or window. As soon as the thunder clouds come over the kite, the pointed wire will draw the electric fire from them, and the kite, with all the twine, will be electrified, and stand out every way and be attracted by an approaching finger. And when the rain has wet the kite and twine you will find the electric fire stream out plentifully from the key on the approach of your knuckle."

Now, how would we perform this experiment to-day and with what results? Having flown big kites during thunderstorms, it may perhaps be best to describe step by step two of these experiments, and then speak of what we know can be done, but as yet has not been done.

Our first repetition of Franklin's kite experiment was at Blue Hill Observatory, some ten miles southwest of Boston, one hundred and thirty-three years after its first trial. There were two large kites silk-covered and tin-foiled on the front face. These kites were of the ordinary hexagonal shape, for in 1885 Malay and Hargrave kites were all unknown to us. Fifteen hundred feet of strong hemp fish line were wrapped loosely with uncovered copper wire of the smallest diameter suitable, and this was brought into a window on the east side of the observatory, through rubber tubing and blocks of paraffin. Pieces of thoroughly clean plate glass were also used. Materials capable of giving a high insulation were not so easily had then as now. We knew very little about mica; and quartz fibers and Mascart insulators could not be obtained in the United States. Our electrometer, however, was a great improvement upon any previous type, and far removed from the simple pith-ball device used by Franklin. Knowing that an electrified body free to move between two other electrified bodies will always move from the higher to the lower potential, Lord Kelvin devised an instrument consisting of four metallic sections, symmetrically grouped around a common center and inclosing a flat free-swinging piece of aluminum called a needle. The end of the kite wire is connected with the needle and the sections or quadrants are alternately connected and then electrified, one set with a high positive potential, say five hundred volts, and the other with a corresponding negative value, say five hundred volts lower than the ground.

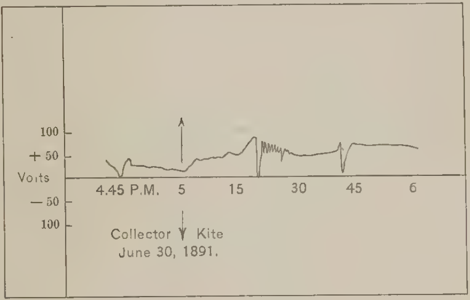

Mascart Electrometer.

Perhaps the most noteworthy result of these earlier experiments was the discovery (for such we think it was) that showery or thunderstorm weather was not the only condition giving marked electrical effects. The electrometer needle would be violently deflected and large sparks obtained at other times. Day after day as we flew the kite we found this high electrification of the air, and we had no trouble in getting sparks even when the sky was cloudless. One other discovery was made, and this would have delighted Franklin more than the other, for he was always most pleased when a practical application was in sight. Seated within the instrument room of the observatory, with his back to the open window through which came the kite wire carefully insulated, and the kite high in air, the observer closely watching the index of the electrometer could tell positively, and as quickly as one outside watching the kite, whether it rose or fell. When the kite rose, up went the voltage, and *vice versa*. In other words, the electric potential of the air increased with elevation. It must be confessed that the kites made to-day would have behaved better and flown with more steadiness than the one we used. It may have been the varying wind, or more likely wrong proportions in the kite and tail; but our old hexagonal kite

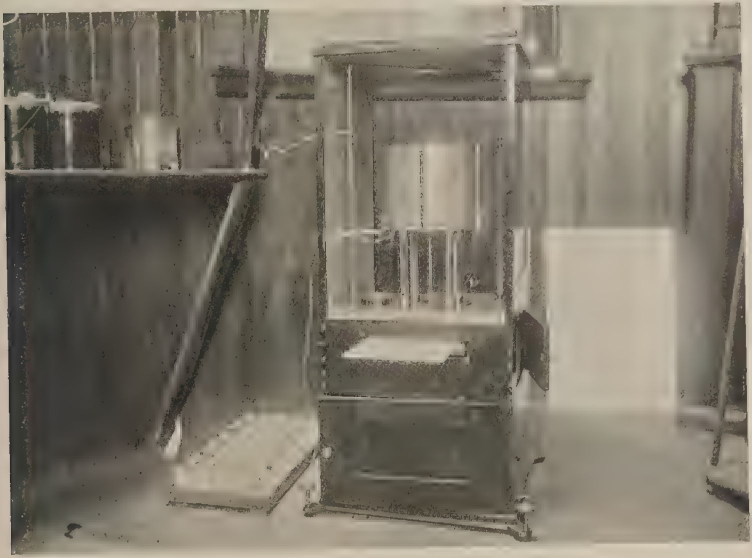
Mascart Electrometer, with Photographic Register, July, 1892.
Blue Hill Meteorological Observatory.

would dive even when high in air. Once we kept the kite aloft from the forenoon until late at night, but that was something unusual.

Passing now over six years in which we had been busy measuring the electrification of the air under all conditions, and discovering, for example, that a snowstorm was almost identical with a thunderstorm in its tremendous electrical changes, we come to the year 1891, when we again flew kites for the purpose of electrically exploring the air. Our experiments at the top of the Washington Monument in 1885 and 1886 (especially those during severe thunderstorms, when we obtained potentials as high as three and four thousand volts just before the lightning), had given us an insight into the strains and stresses in the air, and taught us what to expect at such times. There was still little improvement in the kite, but much better electrical appa-

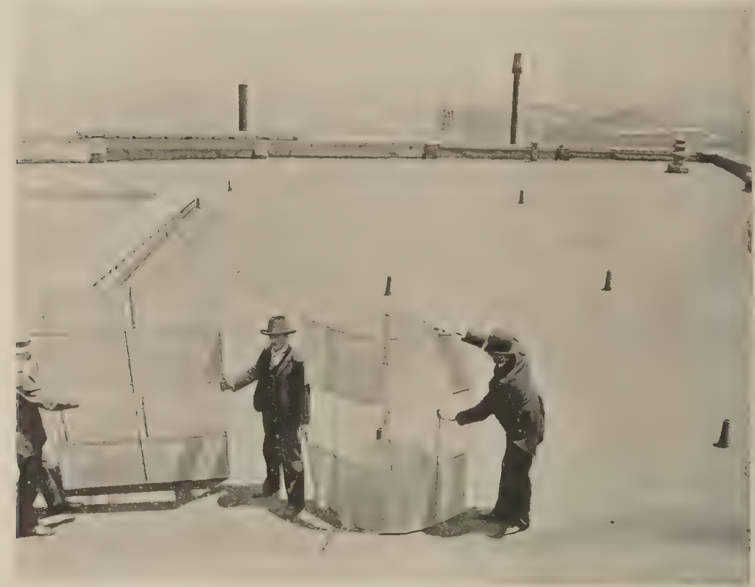


Electrical Potential of the Air. Small collector about fifteen feet from ground; kite about five hundred feet from ground.



Multiple Quadrant Electrometer, July, 1892. Blue Hill Observatory.

ratus was at hand. It may seem ridiculous, but we hauled nearly a wagon-load of electrical apparatus to the summit of the hill, and found occasion to use all of it. Our insulators were delicate glass vessels, curiously shaped, containing sulphuric acid, and able to hold with little leakage the highest known potentials. Besides these fine Mascart insulators, we had hundreds of distilled-water batteries and two electrometers, one a Mascart quadrant, the other a large multiple quadrant. The chief aim that year was to secure by mechanical means (discarding the photographic and eye methods) a continuous record of the potential. When we can study the potential at any moment and still have a record of it, the relation of the electricity of the air to the pressure, temperature, and moisture will be more easily investigated. Among our records that year there is one date, June 30, 1891, where a direct comparison of the electrification of the air fifteen or twenty feet from the ground and at a height of about five hundred feet is shown. In one, the potential was obtained by a water-dropper collector from a second-story window in the observatory, and in the other was obtained by means of the kite. It will be seen how much higher the kite values are, although the kite was a much slower accumulator of electricity. In the next year, 1892, the kite was flown several times during thunderstorms, but generally during afternoon storms; and in the lull



Kite-flying on Roof of City Building.

preceding the wind rush the kite would fall. It was not until August 9th that we succeeded in going through a storm with the kite still flying. About 11 A. M. the kite was sent aloft, and it remained aloft until after 10 P. M. From the observatory one can see to the west fifty or more miles, and a thunderstorm came into view just about sunset. The kite was flying steadily, and whenever a finger was held near the kite wire there was a perfect fusillade of sparks. As the darkness increased, the polished metallic and glass surfaces in the large electrometer reflected the sparks, now strong enough to jump across the air gaps, and the incessant sizzling threatened to burn out the instrument. The vividness of the lightning in the west also made it plain that the storm was one of great violence, and as the observatory itself would be jeopardized, one of the four men present proposed to cut the wired string and let the kite go. But even that was easier said than done, for to touch the string was to receive a severe shock. It was necessary, however, to get out of the scrape, and one of the party took the kite string and broke the connection with the electrometer and insulators. While he was in the act of doing this, the others, who by this time were outside the building, saw a flash of lightning to the west of the hill. The observer who was undoing the kite wire did not see this flash. He saw a brilliant flare-up in the electrometer, and at the same instant felt a severe blow across both arms. Notwithstanding, he loosened the wire, and, dropping an end without, it took but a few moments to make it fast on the hillside some distance away from the observatory. There it remained for the rest of the night. A 105-volt incandescent lamp was placed between the end of the kite wire and a wire

HARGRAVE KITE.

running to the ground. There was some light, but no incandescence of the filament. It was more in the nature of a creeping of the charge over the outer glass surface of the lamp. Stinging sparks were felt whenever the kite wire was touched. The storm gradually passed over, the lightning being vivid and frequent in the west and north, and, as we learned next day, doing considerable damage. The nearest flash to the hill, however, as well as we could determine by the interval between thunder and flash, was forty-five hundred feet away, so that the discharge which the observer felt while loosening the wire must have been a sympathetic one. We obtained a photograph of the prime discharge, and very curiously this shows a remarkable change of direction.

Hargrave Kite in Air. Same kite as in preceding cut.

This year, in some interesting experiments made on the roof of the Mills Building at San Francisco, it was noticed that the roof, which has a covering of bitumen, was a good insulator. Ordinarily one may touch the reel on which the kite wire is wound without being shocked, but if a wire be connected with the ventilating pipes running to the ground there are small sparks. Introducing a condenser in the circuit, the intensity of the spark is increased. It only remains to construct an appropriate coil of the kite wire and place within it another independent coil. In the outer coil a quick circuit breaker may be placed, and theoretically at least we shall transform down the high potential and low amperage charge of the air to a current of less potential and greater amperage. This can be put to work and the long-delayed realization of Franklin's plan of harnessing the electricity of the air be consummated. It may not be a profitable investment from the commercial standpoint, but no one can say what this tapping of the aërial reservoir may lead to. Determining the nature and origin of the aurora will be as great a scientific achievement as utilizing the energy of Niagara Falls.

THE PSYCHOLOGY OF BELIEF.

By W. B. PARKER.

IN considering the psychology of belief we find ourselves face to face at the very outset with the questions: (1) What is the nature of belief? (2) What are the conditions under which it arises? and (3) What are the causes for its appearance? In trying to answer these questions we have to say frankly, before crossing the threshold of the topic: We have no key to secret chambers; we propose no revelations, but only another look over what may be very familiar premises.

To the question, What is the nature of belief? many answers have been given. Hume declared, "Belief is nothing but a more vivid, lively, forcible, firm, steady conception of an object than the imagination alone is ever able to attain." Prof. Bain said, "Belief in its essential character is a phase of our active nature." The answer we shall give to the question shall not necessarily conflict with either of the answers given above. It is best given by defining our point of view.

We look at man as a physical organism of rare sensitiveness, played upon by the forces of the world. Light and sound, the blowing wind and the solid ground, all make their varying sorts of contact with the delicate, susceptible organism. But not all of the myriad voices are heeded, not all the thousandfold seductions entice, not all the sweet odors or the pleasant touches of the great world call forth response. In fact, this human organism is not unlike that lowlier organism, the sponge, through whose length and breadth streams from the great ocean flow. There is no current in the Atlantic, no distant sea, however narrow, but may send its contribution of richly laden sea water to the sponge's mouth. But not all the nitrogen, carbon, iron, that the tide bears is taken up by the sponge. It extracts only what it needs, what it can assimilate, and to most that passes remains, perhaps, insensible. So with our more complex organism—man. He, too, is set in the midst of oceans of sensation. Sounds, sights, odors, tastes, and touches flow round him in limitless variety. Of many, perhaps of most, he is never conscious; to only a few does he respond.

Objection may be made to the analogy, but on examination I am sure it will be found to be sufficiently close for our own purpose. To the mind, sounds, tastes, colors, odors, and sights are what foods are to the sponge—they are stimuli. Specialists on the eye tell us that the range of light vibrations to which the human eye responds is but a little break in a great series, like a short stretch cut out of the middle of an inclined plane. So, too, with our ears. They can intercept only a few of the possible sound vibrations that make up the world of noises. As the sponge, then, comes in contact with but the merest vialful of the great ocean, the human organism also makes contact with mere fragments of the world's infinity of stimuli.

There is a second respect in which the analogy holds good. Just as, out of the limited flow of food-laden sea water that passes its doors, the sponge chooses what it needs, what it can assimilate, so the human organism, out of the limited variety of stimuli to which it is competent to reach, chooses such to respond to as are important.

Now, what has this to do with belief? Simply this, that belief, whatever else it may be, is a human function, and in so far as it is vital and important it must be subject to the fundamental laws of the organism. We can neither believe nor disbelieve what we never come in contact with, and the stress of life causes us to believe only what is important to us, as the sponge absorbs only what will nourish it. I do not say we are incapable of believing a thing that is useless for us. It is possible for an organism to take and to treat as food that which is valueless. But in the main, life means taking what is good, and taking what is not good means death. This is as true of the mental life as it is of the physical life, and for the most part the process of choice is instinctive and unconscious. When the thermometer falls we have sensations of discomfort—we may respond by taking off our clothing. It is conceivable that we should believe it is getting hot. But we do actually respond by putting on our overcoats, which is good evidence that we believe it is cold.

This, I take it, is what Prof. Bain meant when he said, "In its essential character belief is a phase of our active nature," and I do not think it conflicts in any way with Hume's account of belief as a "more vivid, lively, forcible, firm, steady conception than the imagination is able to attain." In fact, both of these accounts seem to me very true. What I mean by believing my friend's word is not that I have a clear perception that his words represent definite things, but that I conceive the main thing he describes or the opinion he declares in a thoroughly lively way—in fact, so warmly do I embrace it that I am willing to act upon it.

The nature of belief is to be a part of our active nature; it is related to the will. We believe a thing when we accept it and are willing to act upon it.

We set for our second question, What are the conditions under which belief arises? These are of two kinds. There are mental conditions and physiological conditions.

The physiological conditions of belief will of course be primarily those, if there be such, which are indispensable to all mental activity. Now, since of physiological activities in general there is an unfailing register in the circulation of the blood—i. e., innervation of muscle or nerve at any point is accompanied by an increased flow of blood to that point—we may take the flow of blood as one means of registering physiological activity. With this as a test we can affirm that there are physiological conditions for all mental activity. In fact, the investigations of Mosso, the Italian physiologist, enable us to measure the increased flow of blood to the brain which accompanies simple mental operations. A delicately balanced bed scale on which the subject is placed reveals the fact that the simplest mental operations, as answering a question or working out a problem in mental arithmetic, is registered in increased weight of the head—i. e., greater blood supply. Increased rapidity of circulation is then a prime physiological condition of belief. This gives a key to the conditions under which belief arises. In general they may be summed up under one head—heightened vascular and nervous activity.

If we stop and ask ourselves how did we come to believe such and such a thing, we shall find in almost every case that it was under excitement. Did ever a girl sit down calmly and reason to the conclusion that she was in love? Did ever a man or woman reason to the conclusion that he or she was saved? No, belief does not come that way. Every orator learns that. It is not the close-woven, incontestable argument that leads to belief. It may be a good preparation, but often the result can be gained wholly without it, and I doubt if it is ever indispensable. Men and women are moved to believe, not by argument but by aroused feeling. Just as when anger is aroused some outlet must be had, so when the active nature is aroused something must be believed. The person who at a revival meeting happens to be unmoved, finds it hard even to conceive the intensity of conviction which possesses the kneelers at the mourners' bench.

Anything, then, that arouses the physical activities may be expected to stimulate belief. This will be found to be true. Excitement of any sort seems to quicken conviction. Stimulants arouse belief. I hope some one will make a thorough study of this matter. I am convinced it would repay the labor. The different effects produced by different sorts of stimulants would make a valuable contribution to this subject: for instance, coffee seems to awaken almost as many doubts as it lays, while alcoholic stimulants seem invariably to dispel doubt and enthrone certitude.

Some men depend upon their pipe to give them the needed start to the conclusion of problems. I confess that I seldom feel so sure of the solidity and reality of the world as when I have my favorite amber stem firm set between my teeth. And much of the tenacity of religious conviction of our Methodist and Baptist brethren is due to conceiving the articles of their creed with passion bred in the excitement of camp meetings.

Perhaps more marked than any of these is the effect of sexual feeling. It is practically impossible for either of two people to believe in the love of the other without feeling some warmth of feeling himself. It is the feeling that awakens doubt or conviction.

This leads naturally to the interrelation of feelings and beliefs. The close relation of love and religion has been a topic for ages. It is, I think, remarkable how many women disappointed in love turn to religion for consolation. Girls and women who have never revealed the slightest interest in church or creed become, under the influence of an unrequited passion, the most ardent believers. There is no reason in such cases to charge hypocrisy. They only show how much belief depends upon emotion. It is as if the feelings, deeply stirred, must react strongly. So long as the nature is left passive, belief, whether about love, politics, or religion, seems needless; but once the feelings are aroused, a hunger appears that demands satisfaction in some conviction or other.

The physiological conditions of belief, then, are, in a word, stimulation—excitement. There are also, as we agreed, mental conditions of belief. These are, as follows from the volitional nature of the function, such as conduce to a heightened state of all the mental activities, but especially the imagination and the affections.

Repetition or pondering over a matter helps us to believe it. We accept many a thing by its familiarity. Many of our creeds are believed in this way. The mental condition of acquiescence is brought about by frequent repetition, just as memory is made firm by the same means. Pondering over things, themselves imaginary, makes them real to us. Prophets come to believe in themselves and their mission, not so much by reasoning about it, but by steadfastly fixing the goal of their desire in the mind until, out of a fancy, it grows to a clear conception, and from a conception becomes, for them at least, a reality. So with us all;

we gain rest in belief often by putting reason out of doors. Maudsley says: "To say that the great majority of men reason in the true sense of the word, is the greatest nonsense in the world; they get their beliefs as they do their instincts and their habits, as a part of their inherited constitution, of their education, and the routine of their lives."

That this is true is shown by popular superstitions. Almost every hamlet in Europe has its own ghost story, believed ardently by the local inhabitants, and scoffed at by those of the next village.

We have insisted that, because belief is a function of the active nature, whatever conduces to greater physical or mental activity will conduce to believing. We are prepared to believe, then, that in joy we believe more than in grief. A low state of mind—sorrow, remorse, melancholy—is a field where doubts grow rank, but the cheerful, successful, hopeful mind finds belief easy. It is failure that makes us cautious; success emboldens us and like rumor, multiplies as it goes, loosing our fancy and making credible what was but just now impossible.

Again, inaction kills belief, while action of any sort nourishes it. Phillips Brooks was fond of saying, "Do something with your religion, and your religion will not die." So with all our beliefs. Though it is often bred in our mind by pondering things over, calling up images until they become fixtures, belief is oftener born and nourished in earnest action. Lincoln's life gives a notable example. In his pioneer days he was a skeptic. Both Lamon and Henderson say that up to the time Lincoln went to Washington as President he was not a professing believer in any Christian faith. But during the days of the war, when Lincoln bore tremendous burdens of action and anxiety, embodying and enforcing the will of the nation, he became thoroughly religious. It is told that in 1864, when the tension was at its highest, and Lincoln's life was like the action of the heart of the whole people, in that time the President was found more than once on his knees at prayer. Lincoln's faith did not come to him by reasoning, but in the stress and strain of life. He laid hold upon certain great truths with the grip of a hungering and thirsting nature. It is in this way, I believe, that the strongest faith is attained. With his whole nature stretched to its highest tension, no man can avoid conviction. So long as he merely rests, remains inactive, passive, he may get along without a faith; but when his soul is awakened and his feeling is aroused, believe he must.

We have seen that in both sets of conditions for belief, physiological and psychical, the same thing holds; because belief is a function of our active nature, whatever stimulates and rouses to action promotes belief.

We may now turn to the third question we set ourselves: What makes us believe? In general and roughly, the answer to this question is—the vital impulse. We believe because we want to, because we have a constitutional trend toward belief. This follows from the fact that belief is a form of action, and we are driven by a passion to act. I have said this is constitutional; it is the very inwards of our vitals; there is nothing that so sums up the meaning and essence of life as the passion to do. A living organism is more than a tense spring; it is a spring growing constantly tenser and fretting to unleash its own forces. This vital tension makes all consciousness motor, and makes every idea a discharging force with inevitable consequences in overt act or intraorganic disturbance. To apply a suggestion to an active mind is like applying anything to a baby's mouth. Both alike show an instinctive tendency to close on whatever offers, be it sealing-wax or sweetmeat. We see this plainly in the workings of a savage mind. For a savage to conceive anything vividly is to believe it. Some such indiscriminate appetency of belief offers the only sufficient explanation for the vast higgledy-piggledy mass of superstition that belongs to primitive peoples.

This is, I take it, what Bain meant when he said that the chief fact of belief was primitive credulity. We are all naturally and primarily credulous; skepticism is a later development and comes from the sort of experience that makes sadder but wiser men of us. It is in life itself, in its appetency, its passion to act, that we find the prime cause of belief, which is, in fact, merely a gratification of this vital desire. As the sponge needs no other justification for absorbing nitrogen from the sea water than its own nutritive instinct, we need no other excuse for believing than the instinct of activity.

Yet this is but one side of the matter, and plainly enough the rougher, more general side of it. I eat because I want to, is but an imperfect answer to the question why I eat, and even the addition that I eat because the vital processes demand satisfaction that can be provided only by food, still leaves the matter much beclouded. In putting down belief as the gratification of a vital desire, we have only found the big, crass motive for believing. To answer fully the question, why we believe, demands that we go further. We must be prepared to find here, too, that the ground is an organic, constitutional one. The first reason for believing at all is because we are alive, not dead, and crave action, not torpor. The reason why we believe *as we do*, and the sort of things we do believe, is because we have the sort of constitution we have. We have seen already that, of the myriad sights the sun makes, only a slight proportion affect our retina; we have learned that of all the thousandfold possible excitants of nerve and muscle, comparatively few ever produce in us sensation. This is matter of mere physical organization. We are conscious of a much more important selective process. We know that we do choose what things we shall respond to, and what not. We are now brought to see the two chief phases of belief, the voluntary and the involuntary sides of it.

Much has been said of the uncontrollable nature of belief. This is no mere fancy. We do believe in an involuntary sort of way, much as a child puts everything into its mouth. In fact, Prof. James has said, "Whatever is uncontradicted is *ipso facto* believed." In such a sense as this, belief is uncontrollable. But the other side of the matter is more important. We may will to believe—that is, we may choose what we will believe and what we will not believe.

This possibility of choice depends upon two things, one subjective, the other objective. To the former fact Prof. James has already called attention in pointing out that the same things may seem different to us.* My table-top, for instance, will look like a rhombus, a square, or an oblong rectangle, depending upon the point of view. I deliberately choose to regard it as a square, and in so doing ignore the other aspects, which none the less remain equally true and real. The second fact upon which the possibility of choice depends is a matter of mental constitution. Prof. Royce gives this a very clear statement. "We are prejudiced," he says, "in favor of regularity in the world; and so we continually manipulate the data of sense for the sake of building up a notion of a regular, necessary, and simple universe." Just as the sponge, again, by its constitution of calcareous outer skeleton and soft inner substance, must prefer to absorb from the varied materials offered by the passing current lime and carbon, so we choose what we choose largely per force of our racial and individual constitutions.

"And so," continues Prof. Royce, "though it is true that our knowledge of the world is determined by what is given to our senses, it is equally true that our idea of the world is determined quite as much by our own active combination, completion, anticipation of sense experience." † It is unnecessary to repeat the arguments upon which the conclusion Prof. Royce reaches is based. I have already indicated them. Because we can receive more sensations than we can follow, we choose to reject some and retain others, thus carrying out consciously the selective process that our organization unconsciously begins. Now, what Prof. Royce emphasizes is the fact that this conscious process of selection, which is inevitable, follows certain lines, namely, of simplicity, necessity, regularity. As he puts it, we are prejudiced in favor of certain aspects of the world, and impose them upon the phenomena with which we come in contact.

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* Prof. James, Principles of Psychology, vol. i, p. 285.

† Religious Aspect of Philosophy, p. 322.

This brings us again to the active side of belief. To quote Prof. Royce again: "Every one is certain to be prejudiced, simply because he does not merely receive experience, but himself acts, himself makes experience." That is, everybody makes his own belief, his own knowledge to some degree. And if we will only watch closely our own mental movements during the process of coming to a decision, we shall see how true this is. During such a process there is a period of balancing one side against the other, of more or less keen scrutiny of reasons, of swift discussion back and forth, accompanied by a tension and excitement rising to the height of exaltation. There is perhaps no attitude in which the mind shows greater activity than this of questioning. We have many times felt the drop that comes with decision. The swift and agile leaping back and forth, the piercing looks cast on this side and on that, are all stopped, sometimes for very weariness, but almost always with a slight sense of depression, like settling after flight. The act of deciding, of accepting one of two alternatives, does really seem, at the moment of doing it, like a lower form of action. It is not intellectual, but volitional. I am quite sure no man ever chose a sweetheart without a little sense of coming down from the freedom and daring of uncertainty. It is like the feeling we may imagine a cloud to have on condensing into rain. It has become effective at the cost of freedom and elasticity. This condensing, dampening turn of conception is belief, and it is our will, our activity, the momentum of our life that bring it to pass.

Though belief is thus primarily an expression of the instinctive force of life, determined by intelligence and choice, what we may believe is a matter of circumstance. To believe what one has never heard of is manifestly impossible. Further, inasmuch as belief means laying hold on a conception, accepting it as a basis of action, it is necessary not only to have the matter come before one's mind, but also to attend to it—to see it clearly. Hume was right in insisting on the liveliness, clearness, permanence, and firmness of the conception that is believed. We do not as a rule believe our dreams, but let a dream recur again and again, and few of us will be able to refuse it credence. Many things come to be believed by their traditional weight of authority. The creeds of Christendom have come down to us with the force of centuries behind them. They are accepted in their traditional form chiefly because by multitudinous repetitions they have been beaten in upon the mind, and in most cases have been yielded credence without question or reasoning.

Finally, at the peril of tediousness, let me repeat, belief is a vital function. Whatever arouses and stimulates the active nature, looked at from the physiological or psychical point of view, helps to awaken and further belief. The forces that we call life make for belief. We all want to believe. Primitive credulity is an experience for us all, and it is just this vital side of it that accounts for our tendency to accept rather than to reject. So long as belief remains an active function, and so long as life remains a bundle of functions united to delight in their activity, we shall have a healthy desire to believe rather than to doubt.

FREE-HAND DRAWING IN EDUCATION.

By H. G. FITZ.

MR. CHARLES WHEELOCK, Head Inspector of the Regents of New York State, voicing the opinion of fifty-five hundred teachers in this State, says, that for the twenty years during which drawing has been a part of the curriculum of the public schools, "*the results are not much of anything.*" *

This statement, coming from such a source, is worthy the careful attention not only of teachers, but of all taxpayers as well. If true, it seems that for each child in the public schools of this State about forty hours a year are wasted; this means an aggregate of years of time and thousands of dollars.

The Art Students' League of New York city gathers pupils from most of the States in the Union. It stands second to no art school in America. Mr. Henry Prellwitz, a well-known artist of this city, and instructor of the portrait class at the Pratt Institute, Brooklyn, N. Y., has for some time past been Director of the League, and has had ample opportunity for studying the work of those admitted to the classes. His opinion is that "applicants who have been trained in other than pure art schools have *received no benefit from their lessons in drawing*; their efforts have been misguided, the undoing of which results in loss of time, and their progress is less rapid than those who have received no such previous training." Mr. Edward A. Bell, a well-known figure painter, who was awarded the bronze medal at the Paris International, also second Hallgarten prize at the New York Academy of Design, who has had several years' experience as a teacher, agrees entirely with the opinion expressed by Mr. Prellwitz. Mr. Dwight W. Tryon,[*] N. A., Professor of Fine Arts, Smith College, whose reputation as an artist is international, whose pictures have been practically loaded with medals, the list of which would be too long to publish here, has had vast experience as a teacher, but has taken no note of the previous training of the pupils that come under his observation. He says of the average adult, "The power of observation seems *hopelessly atrophied.*"

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* School Journal, June 10, 1896, p. 728.

The above-quoted opinions of men who have a reputation as artists in the highest art circles seem to corroborate Mr. Wheelock, and extend the application to the whole country, the opinion of the "art teachers' associations" to the contrary notwithstanding.

The late Mr. William M. Hunt, reputed one of the ablest art teachers of America, said to his pupils: [†] "You don't drill enough. None of you know what mechanical drawing is. Go into the schools where that and nothing else is taught, and try to add their exactness to what you are now doing. . . . One thing let me tell you: you must learn to make exact lines." [‡] This opinion, held almost universally, that the mechanical drill of drawing exact measured lines and spaces leads to the exact observing of lines and spaces, form and color, has led to the use of *mechanical drawing methods* to obtain accuracy of location in educational free-hand drawing. It seems plausible; but mechanical drawing, like writing, is to a degree technical. "What arts and skills a young man may learn of any master for the sake of mere advantage is in itself just as indifferent to the educator as the color he chooses for his clothes." [#]

By actual measure the error that will escape the effort of the mechanical draughtsman, directed for fifteen minutes to its removal unaided by any mechanism, will be four times as great as the error that will elude the figure painter for a like time, opinions of the figure painter to the contrary notwithstanding.

The following table shows the error, in inches and fractions, and angle in degrees, that will be left by the average adult recorded in the several vocations named:

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[*] Tryon, Dwight William, born in Hartford, Conn., 1849. Pupil of Daubigny, Jacquesson de la Chevreuse and Guillement. A. N. A. Member of American Water Color Society. Medals, American Art Association, 1886 and 1887. Second Hallgarten Prize, 1887. Ellworth Prize, Chicago, 1889. Palmer Prize, Chicago, 1880. Webb Prize, 1889, and many more. (Catalogue Society of American Artists, 1891.)

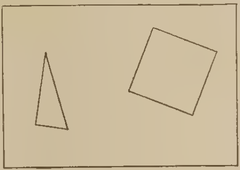
[†] W. M. Hunt. Lectures, second series, p. 17. Houghton, Mifflin & Co., 1883.

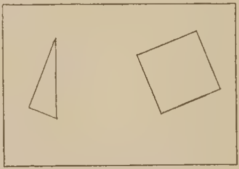
[‡] Ibid., p. 36.

[#] Herbart. Introduction to General Pedagogics.

A.*	Figure painters of national repute	·08	2°
B.	Landscape painters, *telegraph operators*, coasting and yacht mates and masters, village blacksmiths, expert baseball players	·17	4°
C.	Mechanical engineers	·30	7°
D.	Mechanical draughtsmen	·40	9·5°
E.	Teachers, journeymen house carpenters, farmers thirty years old or more	·50	12°
O.	Children eight years of age	2.00	50°

To remove opinion the test must be equally new to all tested. It must be easy enough for the child of eight to draw quickly; difficult enough, so that the most expert of any age will be unable to reproduce it perfectly. To be novel to all it must be abstract. The above table is the result of measures obtained in the following way:


Test No. 1
ASSISTED ATTENTION.


Test No. 2
VOLUNTARY ATTENTION.

Tests No. 1 and No. 2, mechanically enlarged to three feet by two feet, are placed vertically before groups of from twenty to fifty or more individuals. The copies are drawn on paper nine by six inches, and must not be raised from the horizontal position.

The usual mechanical aids to accuracy, such as measuring by the hand or pencil held between the eye and the object, are not allowed in any way.

For test No. 1 the operator calls attention to the chart that is to be proportionally reproduced by words that in no way hint at the position or proportion, and by motion, pointing out and holding for a few seconds, until recorded, each point on the chart. The time consumed will be about two minutes, and the result tabulated for age and error may be read in line No. 1 on large chart, *showing no variation for age.* The least error is nothing; greatest, six tenths of an inch; average, three tenths of an inch. Between this line and the top of the chart lies all the error of eye and hand. *The eye of the child sees as accurately as the adult's.*

Test No. 2 is to be drawn under exactly the same conditions as the above, except that *no word or motion must aid the attention* of those drawing, either to the chart or their copy of it. The attention given it must be *voluntary.* The result, measured and charted by age, position, and angle error, may be read for any age—eight to twenty—on line No. 2. This curve is the center of groups selected and associated by the school examinations into classes. The adult end of it (seventy-five per cent) is the position of the center of groups trained in the schools of the United States and part of Europe. The adult farmer who does nothing else stands on exactly the same center as those graduated from the high schools and colleges who have been licensed to teach. The *youth* of the rural districts *stand five per cent higher than the adult*, but they will not all be farmers; many of them will drift into the cities and become successful business men with a center at eighty-five per cent or more, which is the point of accuracy attained by *all* those of *any profession reputed by co-workers* to have marked ability, which means, as read from the chart, the successful have as much power to direct their own attention to the uninteresting thing as can be lent to them by external aid. That the *average school training has carried* those who have followed it *no nearer success in drawing than those who have not been so trained* seems to go far toward taking Mr. Wheelock's statement out of the realm of doubt and extending the scope of it to the school drawing of Europe as well as to the "great State of New York."

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* These letters will be found on chart, indicating the relative position of the centers of these groups.

Not the least singular of the facts brought out by these experiments is that, while the figure painter (position A) needs ninety-five per cent of the power measured by the test, and the landscape painter (position B) has acquired ninety-two per cent by years of labor, the telegraph operator (also position B), whose training certainly has not been toward *eye accuracy*, should also be able to locate by observed proportion and direction to ninety-two per cent. By what means did he get the power to locate with an accuracy almost double that possessed by the average mechanical engineer? The telegraph operator has been trained in *voluntary attention* to such an extent as to be able to listen to certain sounds, *not in themselves interesting*, and *inhibit* all others. Herbert Spencer says success in everything depends on the power of observation.

It seems that the foundation of the power of observation is *voluntary attention.*

Balzac is quoted as saying, "Almost the whole of human genius consists in observing well." And Taine writes, "Success in life depends on knowing how to be patient, how to endure drudgery, how to make and remake, how to recommence and continue without allowing the tide of anger or the flight of the imagination to arrest or divert the daily effort." *

Prof. William James writes: "The faculty of bringing back a wandering attention over and over again is the very root of judgment, character, and will. . . . An education which will improve the faculty will be *the* education *par excellence.*" *

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* Art in the Netherlands, p. 23.

Whether any one, in the ordinary lay interpretation of the act, is ever able to draw or not is of very little educational importance. But, since we see that the ability of the telegraph operator to attend by ear gives him also the power to attend by eye, we may infer that training to *conscious and effective* effort by one sense trains all others to some extent. The inference seems rational that training one to *attend* by eye will strengthen the power of observation in all directions.

The above-quoted opinions all seem to point to the ability to set aside the things that clamor for attention and attend to those that ordinarily escape our observation, as the foundation of success.

Line No. 2 (on chart) differs from line No. 1, because the subject must, before an attempt to locate is possible, determine which of the points will be taken first. This having been selected from the seven and located, six remain. The choice must be made six times, the location seven, each of which is the result of a distinct conscious effort of the will in "bringing back a wandering attention," which, if left free, would be like Huldy's feelin's described by Lowell:

> All ways to once her feelin's flew
> Like sparks in burnt-up paper."

To arrest those sparks, bring them back, and hold them for a fraction of a second, means a considerable conscious mental effort, each of which brings nearer the state where fatigue prevents further effort and the sparks are followed instead of driven; hence the curve.

The very young child has a good conception of the vertical and horizontal positions and of their conventional representatives in lines. But when the line is oblique, the *concept* of it, as oblique, is altogether insufficient for representation. It slants right or left. This or that end is high, how much? †

The composite drawing of fifty-three pupils, average age eleven (position on chart at ⊖, a year and a half above the average of their age), shows the vertical recorded nearly upright fifty-one times, greatest variation twenty degrees, while the oblique lines of the trapezium show the maximum possible variation forty-five degrees, with few lines near the right slant.

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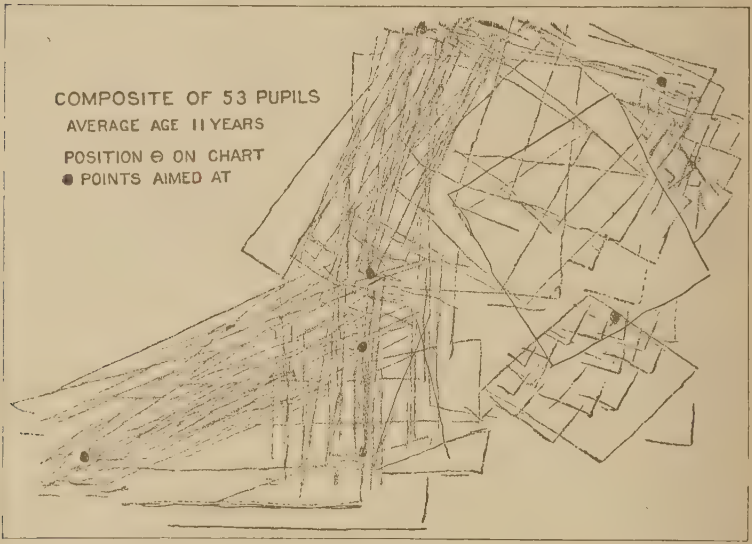
* Psychology, William James, p. 228.

† In the tests for line 2 no lines were horizontal, none vertical, none parallel to each other or the margin of the paper, no line prolonged would hit an angle. On the nine-by-six-inch paper the triangle sides were 3·4 inches, 3·05 inches, 1·55 inches. The longer diagonal of the trapezium measured 4·1 inches; the sides, 3 inches, 2·87 inches, 2·90 inches, and 2·86 inches. The measurements for the chart were obtained by placing a test sheet over the drawn one, matching the edges with care, and making with a point holes for the true positions of corners, as mechanically located on test sheet. The errors were aggregated on a slip of paper and divided by the number of points (7). The greatest angle error was then selected and divided by 24 (because that figure seemed to make the angle error coeffective with the distance error). The result is added to the average of the first,



The so-called child drawing, so much written about of late, that Herbert Spencer and many others deem of educational importance, may be described as line making without conscious effort—the graphic record of a muscular movement associated with a concept. It becomes more plausible as years advance, but never gets beyond caricature, and has no direct educational value.

Drawing, to have educational value, must be the graphic record of a perceived fact.

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divided by 2. To get per cent, divide by 2 again and subtract from 100, because $\frac{2}{100}$ inch = 1 per cent. Thus, total error, 2·1 inches; greatest angle error, 7·2°.

2·1 ÷ 7 = ·3;   7·2° ÷ 24 = 3;
·3
·3   100
·6 ÷ 2 = ·3 ÷ 2 = ·15;   ·15
85 per cent.

When time is limited and an approximation is desired, the greatest angle error treated as above will give a result within two per cent of an average for a class.

The angle error may be ignored where the personal position is not desired, as it will change the average center but little, the personal position very much, particularly of the concept recorders.

The drawing in itself is of no consequence except as it stands for the record of an *exploration* and *discovery*. The teacher, to succeed, must be able at a glance to determine whether the child is recording concept or percept.

The result of training the child to *explore, discover,* and *record* is shown by the dotted line beginning at the eleventh year on line 2 of large chart, ending at fourteenth year (No. 30). This line is the history of a parochial school. The pupils had thirty minutes' exercise a week for about thirty weeks a year up to the first circle, from then on one hour a week for about thirty-five weeks a year. The average rate of increase in power of observation equals maintaining the average rate from the ninth to the tenth year, to the fourteenth; twenty per cent above the average of their age, ten per cent above the adult average. The line beginning in a circle at the sixteenth year, ending at nineteenth year at No. 19, is the history of a high-school class under the same drawing teacher as the above described. They received four times the training (one hundred and eighty hours a year) given the parochial school, and made, as the chart shows, exactly the same increase in two years that the former compassed in eighteen months. All the lines between these two are of classes trained by the same drawing teacher and the same method; the numbers in which they terminate indicate the number of pupils of which the circle is the center.

Is it not possible that between the lines 30 and 19 we may read the record of the atrophy suffered because of too much instructing, by putting the child in possession of facts instead of faculties, described by Dr. H. E. Armstrong, F. R. S., and in the article* in which he also writes: "In the future *all subjects* must be taught *scientifically* at school, in order to inculcate those habits of mind which are termed scientific habits; the teaching of *scientific methods*—not the mere shibboleths of some branch of natural science"?

We see by the chart that the class that began to study drawing as a science at eleven, at twelve and a half had reached seventy-seven per cent, three and a half years in advance of the later class; they reached eighty-five per cent four years in advance of the (31) boys of the high-school class, and that at an *expenditure of one fourth the time.*

The value of this training is necessarily a matter of opinion. The regular teachers of the classes shown on the chart at positions 29, 28, 33, 51, 39, 44, estimate that the one hour per week exercise in drawing as a science study, by the reduction of time required for a certain subject, makes the class of fourteen years equal one of fifteen years not so trained. Four of the teachers place the gain at from forty to fifty per cent in study power. One teacher (class position 44) puts the gain at one hundred per cent in geometry, claiming to have covered certain ground satisfactorily in half the time usually needed for a class without the special training.

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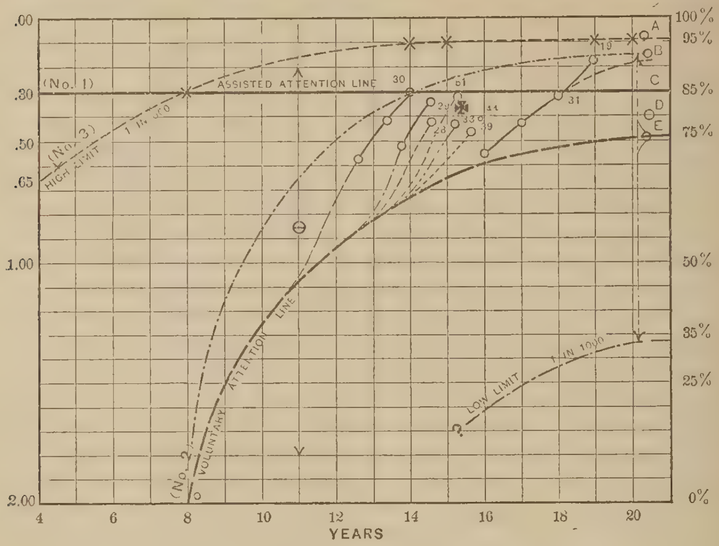
* Popular Science Monthly, September, 1894.



Explanation of Marks on Voluntary Attention Chart.

21,600 measurements of 2,700 individuals.

The error to two inches may be read in tenths of an inch at right-hand end of horizontal line, at the left end read up the lines are five per cent apart; 0 per cent arbitrarily placed at eighth year; vertical lines divide year spaces fourth to twenty-first.

Line No. 1 (at thirty inches and eighty-five per cent).—Externally sustained attention. All those reputed by coworkers to be superior are at or above this line by test No. 2.

Line No. 2.—Voluntary attention. Average line of centers of groups trained in the schools of many States in the Union as well as Europe.

Line No. 3 is the high limit of the above and ends in A. × marks the individuals through which the line is drawn. From fourth year to fourteenth all are females. From fifteenth year up all are males. **?** Marks the rather doubtful lower limit of groups.

⊖ Marks center of composite drawing, average age eleven. ⌃⌄ High and low limit marks.

▨ Marks the center of three hundred and seventy pupils trained by free-hand drawing as a science study.

O Marks known positions.

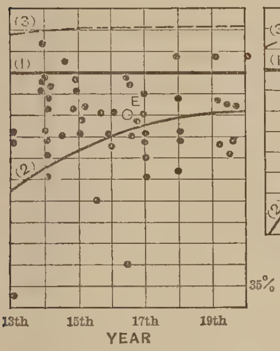
━━ Movement between measured centers.

------ Supposed movement.

○A Figure painters measured in the order named: E. A. Bell, Clark Crum, C. C. Curran, Kenyon Cox, Joseph Boston, Arthur B. Davies, Henry Prellwitz.

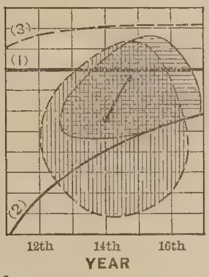
○E Fifty-three teachers. ⌃⌄ High and low limit marks.

By imagining line No. 3 (the high limit of group) prolonged downward and to the left, three years, and line No. 2 treated in the same way to the same age (one year), it will be seen that at the age of twelve months children are almost infinitely separated in power of observation. At eight the average has reached, through the training of life's experiences, to within hailing distance of the leaders eighty-five per cent away; at fourteen the average will be seen to have gained on the leaders so much that only thirty-two per cent divides them. At twenty only twenty-five per cent stands between the average and the highest human attainment. By a more complete co-ordination of scientific and educational methods, I believe there will be no trouble in raising the average, now at line 2, to the dotted line above it, beginning at eighth year, passing through (Fig. 30) at fourteenth year, ending at (B) twentieth year.

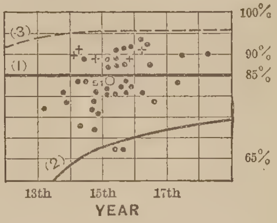


Group E.

● Personal positions of fifty-three teachers. Ages placed at thirteen to twenty for comparison.
○ Average center.



Change in form of class (29).
•——• Centers six months apart.



● Personal positions of fifty-one pupils, class (51).
○ Center.
+ Successful competitors for Pulitzer scholarship, 1896. Fifty per cent of the candidates came from this class.

This would make the power of the average child at twelve years, by the above-described test, equal to that now acquired by the average adult, and the gain would not be attained by giving power to a few already bright pupils who do not need it, but by bringing all those now weak up to or above the present average. (See charts 51 and 29.) The position of the fifty-three teachers * (chart E) represents as nothing else could the value of the instruction received in the common and high schools in which they were trained, of which Mr. Wheelock says the results are "not much of anything." On this chart we find *five* individuals *above the eighty-five-per-cent line,* while chart 51 shows *nineteen higher than eighty-five per cent* and only *two below* the *average line,* as compared with *sixteen below* in the *former group.*

The unsatisfactory condition mentioned by the Regents' Head Inspector is due almost entirely to the methods of examining drawing. Teachers will teach for that which the examiner seeks, and the drawings shown will be as free from error, as neat and clean, as the spelling would be under the same plan of examination, and have no more educational value. The ability to locate correctly is the foundation of success in free-hand drawing, and to a great extent in all the graphic arts. It can be as well tested in five minutes as in fifty. A glance at line 1, eighth year, shows that if the teacher has *lent no greater aid* to the class than *sustaining the attention* during the exercise, the drawing that would without that aid be so badly located as to be almost unrecognizable may be made to appear on the eighty-five-per-cent line, ten per cent better than the average adult unaided would make it. That this is true will be recognized by all teachers who have studied the exhibitions of pupils' drawings where a whole class *seems* to do excellent work. Sustaining the attention of the pupil is invaluable in instruction; by its power the child of any age above eight may learn as much fact in two minutes as the average adult can *unaided* in fifteen (see lines 1 and 2), but sustaining the attention makes *voluntary effort unnecessary*; that which makes conscious effort needless makes it *impossible*. The power to direct the attention unaided by outside stimulus becomes atrophied, observation impossible. The use of transparent planes, the theory of perspective, and all devices by which "drawing is made easy," only serve to rob it of educational value by putting the child in possession of technical tricks which make *observing* facts of no account.

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* This group may not represent the average standing of teachers at all, and it is only just to the many noble workers in the field of education to state that, so far as measured, all having charge of classes averaging over thirteen years of age range between eighty and ninety-five per cent, as the successful in all vocations do.

Having the child draw the familiar object from Nature is another fatal mistake. The familiar object and language co-ordinate to perfection. The child may study and try to represent the difference between *two* objects as seen without danger, but he will correctly describe that in language long before he can graphically, because he can, while looking, put what he sees into words; but to draw, he must look at a blank page and recall, what? The strongest impression, whether because of the recency, frequency, or intensity of it. I have known the recall to reach back a whole week, a month, three months, because of the greater intensity put into some former effort to observe objects associated with those to be represented, the concept of which the pupil, though fourteen years of age, was powerless to inhibit. It is to this inability to indefinitely continue the inhibition of the conceived thing, rather than to lack of knowledge or defective vision,* that most of the local errors seen in the works of many masters, old and modern, may be attributed.

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* Lucien Howe, M. D. (Popular Science Monthly, August, 1895), seems to think that eyesight plays an important part in accuracy as seen in drawing. The facts do not sustain the idea. A gentleman who has drawn the test twenty times, with an average error for each location of ·075 of an inch, on one occasion made an error of only ·033 of an inch, 1·5°, and at this time it was discovered that so considerable was the astigmatism of his

If the free-hand drawings were set aside or destroyed as soon as made, it would remove the temptation that now exists to waste time in technical finish that might to the pupil's lasting benefit be spent in new effort at discovery, discriminating differences in various inclosed areas, values, or colors.

We might then come to be able to see the beautiful in Nature spread at our feet, and in common things at our very door, and not as now, under the name of *art*, hew down the mind of the rising generation to the narrow notion that the beautiful must be sought only on the canvases and in the conventionalities of the past or present age of interpreters, however exquisite or grand their works may be.

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PRINCIPLES OF TAXATION.

By DAVID A. WELLS, LL.D., D.C.L.,
CORRESPONDANT DE L'INSTITUT DE FRANCE, ETC.

XI.—THE EXISTING METHODS OF TAXATION.

SUBJECTS OF TAXATION.—The subjects of taxation, to use a happy generalization of Justice Field of the United States Supreme Court (Foreign-held Bond Case, 15 Wallace), "are persons, property, and business. Whatever form taxation may assume, whether as duties, imposts, excises, licenses, or direct, it must relate to one of these subjects. It is not possible to conceive of any other, though as applied to them taxation may be exercised in a great variety of ways."

With this postulate we are legitimately led up to the consideration of the ways or methods by which the State or Government, in virtue of its sovereignty, and on the ground of necessity, and solely for its support, taxes or compels contributions from the three above-enumerated subjects, for the purpose of defraying its expenditures.

APPORTIONMENT OF TAXATION.—This department of the subject of taxation, while the most practical and therefore the most interesting, is at the same time the one most obscure, and the one about which there is the most striking difference of opinion among writers on economic and fiscal subjects. The four maxims or canons laid down by Adam Smith in his Wealth of Nations, by

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right eye, which was chiefly used, that when looking at a pinhole ten inches off he saw two, about one tenth of an inch apart, and between these several more, yet the accuracy obtained was the highest ever recorded—98·34 per cent.

reason, as he claims, of their eminent justice and equality, have obtained such world-wide celebrity that they are almost always referred to as of unquestionable authority in all discussions of this subject, and have been thus characterized by an eminent French student and writer (M. Menier) on taxation: "When a legislator," he says, "brings forward a new scheme for taxation, he is always careful to say that it *is not* in contradiction with even one of these rules; and at the same time he never fails to invoke them as authority during a debate, even when he is actually scheming to transgress them."

These rules are four in number, and are as follows: 1. "The subjects of every state ought to contribute to the support of the Government, as nearly as possible, in proportion to their respective abilities—that is, in proportion to the revenue which they respectively enjoy under the protection of the state." In the observation or neglect of this maxim consists what is called the "equality or inequality of taxation." 2. "The tax which each individual is bound to pay ought to be certain and not arbitrary. The time of payment, the manner of payment, the quantity to be paid, ought all to be clear and plain to the contributor and to every other person. The certainty of what each individual ought to pay is, in taxation, of so great importance that a very considerable degree of inequality (I believe, from the experience of all nations), is not near so great an evil as a very small degree of uncertainty." 3. "Every tax ought to be levied at the time and in the manner in which it is most likely to be convenient for the contributor to pay it." 4. "Every tax ought to be so contrived as both to take out and to keep out of the pockets of the people as little as possible over and above what it brings into the public treasury of the state."

But although almost universally accepted as the embodiment of the highest wisdom, the above four maxims or canons of Adam Smith have been and are, nevertheless, open to some criticism. In the first place, they are so general in their nature and so lacking in any precise rule or test for application, that they stand in the light of aphorisms; somewhat as the maxims "Honesty is the best policy," "Never put off till to-morrow what can be done today," etc., to which all respect is always given, except the desirable one of practical use in actual cases. In fact, the originators of the very worst forms of taxation now existing might and probably would plead that their methods or practices were based on the ideas of Adam Smith, or were as near in conformity to them as was possible under the existing circumstances. Again, the first maxim or canon embodies two propositions antagonistic to each other, and one of which can hardly be considered correct; namely, that every citizen should pay taxes for the support of the Government in proportion to his ability. For if, as almost all authorities are now agreed, taxes are the compensation which persons or property pay to the state for protection, then it of necessity follows that where there is no protection, ability is no just guide for assessment. "Where there is no protection," said Judge Story (in the case of United States *vs.* Rice, 4 Wheaton, 276), "there can be no claim to allegiance or obedience." And that Adam Smith did not intend to have his first proposition fully accepted would seem evident from the circumstance that he added to it, and qualified it with these other words, "that is, in proportion to the revenue which they [the citizens] respectively enjoy under the protection of the state." Montesquieu, who wrote at an earlier date, also enunciated even more clearly this common-sense and equitable principle, when he said (see Spirit of the Laws), that "*the public revenues ought not to be measured by the people's abilities to give, but by what they ought to give.*" "And what they *ought* to give," as has been remarked by another writer, "can, of course, be only measured by the benefit they are to derive."

DISCRIMINATING TAXATION.—The proposition that "the subjects of every state ought to contribute to the support of the Government in proportion to their respective abilities" embodies also, and inferentially favors the policy of discriminating taxation, and finds popular expression and justification in the assertion that the rich man needs more protection from the state than the poor man, has more interests to be guarded, and it is therefore right that he should pay more in proportion to his fortune. "It is just," says Sismondi, the Italian economist, "that all should support the Government in return for the protection it gives to their persons and properties, in proportion to the advantages society guarantees to them, and the expenses which it incurs on their account." But the question is pertinent, to whom or to what class of its members does society afford the most protection or render the most service? Is there any standard by which such proportionality can be even approximately determined? To these questions Mr. John Stuart Mill has made the following answer:

"It can not be admitted," he says, "that to be protected in the ownership of ten times as much property is to be ten times as much protected. Whether the labor and expense of the protection, or the feelings of the protected person, or any other definite thing be made the standard, there is no such proportion as the one supposed, nor any other definable proportion. If we wanted to estimate the degrees of benefit which different persons derive from the protection of Government, we should have to consider who would suffer most if that protection were withdrawn; to which question, if any answer could be made, it must be that those would suffer most who were weakest in mind or body, either by nature or by position. Indeed, such persons would almost infallibly be slaves. If there were any justice, therefore, in the theory of justice under consideration, those who are the least capable of helping or defending themselves, being those to whom the protection of Government is the most indispensable, ought to pay the greatest share of its price; the reverse of the true idea of distributive justice, which consists not in imitating but in redressing the inequalities and wrongs of Nature. Government must be regarded as so pre-eminently a concern of all that to determine who are most interested in it is of no real importance. If a person or class of persons receive so small a share of its benefit as make it necessary to raise the question, there is something else than taxation which is amiss, and the thing to be done is to remedy the defect instead of recognizing it and making it a ground for demanding less taxes."

M. Menier, of France, widely known as a manufacturer of chocolate, but who has shown himself to be an economist of repute and a most valuable member of the French Chamber of Deputies, in a comprehensive treatise on taxation (*L'Impost sur le Capital*, Paris, 1874; English translation, London, 1880) re-enforces the conclusions of Mr. Mill respecting the popular theory of discriminating taxation by different though not less forcible arguments and illustrations, taking as a text the following remark of M. Léon Faucher, another distinguished French writer on economic subjects: "It seems just that he who, thanks to his talents, to his property, or his capital, procures for himself and his family the enjoyments of luxury should pay to the state a tribute proportionately more considerable than he who has only the produce of his daily labor to nourish and bring up his family." "To those," says M. Menier, "who do not reflect, nothing seems more simple than this proposition. A minimum of wants is spared taxation. In proportion as income increases the tax increases. Let us see the consequences.

"A principle is or is not. A principle recognized as true ought never to be given up, whatever may be its apparent dangers. Once admitted, it must be submitted to, followed out to the end, and its consequences accepted. If by following out its consequences we perceive that we are getting at the absurd, we must return to the principle, and subject it again to the touch of observation. There are many who content themselves with stopping halfway, not daring to advance, and afraid to turn back to discuss the principle on which they have long relied. They are the inventors of compromises, who adjourn questions instead of solving them.

"But taxation, it is claimed, may be 'wisely progressive.' I know no more concerning a 'wise progression' than I do about a 'wise addition' or a 'wise multiplication.' A progression is or it is not. If it is insignificant, then it is a delusion. The inequality it aims at destroying subsists intact. If a true progression in taxation is established, here are the results we obtain: We will suppose, for example, that the tax ought to be trebled when the income is doubled; then a tax of 10 francs on 100 francs of income would rise to 200 francs on 2,000 francs, to 600 francs on 4,000 francs, to 1,800 francs on 8,000 francs, to 5,400 francs on 16,000 francs, to 16,200 francs on 32,000 francs, to 48,600 francs on 64,000 francs, and to 145,000 francs on 128,000 francs. I conclude that the principle that ends in such a consequence can only be false. What! the tax would one day exceed my fortune! I should be the debtor of the fiscal system that had absorbed more than my revenue. Then it would be for my interest not to augment it! I shall have accumulated only for the treasury, and the more I acquire the more rapidly I shall be despoiled. . . . That system may suit Utopians and retrograde people who completely absorb the individual in the state, but it will not suit those who, relying on facts, think the greatness and wealth of the state ought to proceed from the development of individuals. It may suit those who seek equality at the basis, but not those who seek equality at the summit. The theory of progressive taxation is a vestige of the old prejudice that regarded wealth as an evil, as a sort of theft from the rest of the country, and that it would be equitable to make the rich man atone or make reparation for the possession of his fortune and his pleasures. In warlike civilizations, where wealth was based on violence, it is not difficult to understand the legitimacy of this prejudice; but it finds no warrant in our industrial civilization, where all wealth, to be legitimate, must be based on the appropriation of natural agents to our wants. But the partisans of a wise progression in taxation have found means of escaping from the absurdity of the above consequence—namely, confiscation. They propose that above a certain figure the progression shall stop. Under such a system they would favor him who has but little money; but they would favor still more him whose wealth exceeds a certain limit. If you have £4,000 a year, you pay the maximum of the progression; if you have more than £4,000, the progression vanishes. A principle which ends in such consequences does not exist."

M. Menier's Rules.—To establish a system of taxation which will be equitable and effective without involving the principle of progressive or discriminating taxes, M. Menier regards the following constructive rules as fundamental:

1. Taxation should never be laid on circulating capital, "since every tax that obstructs circulation impedes production in a geo-

metrical ratio." 2. Taxation should be levied on the commodity; never on persons. 3. Taxes should never impede the liberty of labor. 4. Every tax ought to be levied as cheaply as possible. 5. There should be but one sole and single tax—namely, on *fixed capital.*[*]

THE TRUE MEASURE OF THE BURDEN OF TAXATION ON PRODUCTION.—In addition to the maxims, or canons, proposed by Adam Smith, another one, first pointed out by Mr. Edward Atkinson, of Massachusetts, is worthy of being added, and may even be regarded in the light of a fundamental principle; and that is, *that the burden or injurious effect of a tax on production or exchange is not to be measured by the ratio which the tax may bear to the gross value of the subject of taxation, but rather by the proportion which the tax bears to the profit which might normally or naturally result from undertaking a certain line of industry or product.* To practically illustrate this, let us take an example. Let us suppose two men, A and B, to start shops for the manufacture of machinery, each with a capital of $20,000, and that each in his operations expends $20,000 for coal and iron, $40,000 in wages, and $4,000 for transportation of the raw materials to the shops for manufacture. The total cost of the annual product of each shop will then be $64,000, or a little more than three times the capital; and a sale of their respective products, at the net price of $66,000, would yield the owners $2,000, or ten per cent profit. Now, suppose further that under such conditions A has a tax imposed on him of three and an eighth per cent upon the value of his product; it may be a customs or excise tax, or an increased rate of railroad freight. This amounts to $2,000 on the $64,000 of product—no excessive burden, it may be said, and only requiring A to sell his $66,000 for $2,000 additional. But suppose A can not get this $2,000 additional; and he certainly can not if the other man, B, is exempt from this three-and-an-eighth-per-cent tax, or contrives to evade it, and competes with A in the open market. Then, in such a case, this three-and-an-eighth-per-cent tax upon product manifests itself as ten per cent upon the entire investment and absorbs the entire profits which otherwise might have been realized; so that the business of A first drags, then stagnates, and is finally abandoned; while his workmen are discharged, the village where the shop is located runs down, the artisans, shopkeepers, and professional men connected with it complain of hard times and emigrate from the locality or the country, while the railroad fails to confer all the benefit to the community or profit to its stockholders that might be possible. B, on the other hand, exempt from the tax, keeps on working, and when hard times come continues his sales and the occupations of his workmen by taking *five* per cent profits instead of *ten*, and selling his goods, as he can afford to, at reduced prices to meet temporary conditions. Actual practical illustrations of the injustice and disaster consequent on such discrimination in respect to tax burdens and exemptions are afforded on a small scale in the history of much railroad management, and to a larger extent where two nations with different systems of taxation undertake to compete with each other in the sale of the products of their labor in the common markets of the world. We find here an explanation also of the immediate beneficial effects which attended the first tentative measures of reform in the British tariff instituted by Sir Robert Peel in 1842 and 1845, which, although consisting mainly in the removal of numerous small but obstructive duties, nevertheless started British industry forward by leaps and bounds, even before the larger burdens of tariff restrictions were removed in later years.

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[*] M. Menier defines fixed capital as every utility of which the product does not change the identity, as useful machines, instruments of trade, profitable buildings, improvements of land, and the like. Circulating capital, on the other hand, produces utility only by being transformed. It is represented by three elements—materials, goods, money. "Facts prove that the suppression of circulation is a cause of ruin for the land as for every other source of production. Look at Spain since the expulsion of the Moors, who had carried to so great a height the theory and practice of agriculture. The land, having become the property of a few great families or the clergy, was consolidated. Its circulation ceased completely, and production ceased with it."

As the characterizations of "poll," "head," or "capitation" taxes, the only possible form of *direct* taxation on a person, and of the advantages and disadvantages of indirect taxes, through the agency of which the Federal Government collects the largest proportion of its revenues, have been already pointed out, the field of discussion under this head is practically limited to the existing methods of State or local taxation on property and business, in contradistinction to national or Federal taxation, or to the system under which nearly six tenths of all the contributions which the people of the United States make for the support of their governments are assessed and collected.

In Great Britain about two thirds of the revenue of the kingdom is from "local" in contradistinction to "national" taxation —£53,000,000 in 1890. Of this amount some £32,000,000, or about three fifths, is raised by rates on the annual value of land and house property in various localities. The next largest source of local revenue is from tolls, dues, etc., from docks, piers, harbors, ferries, and markets, and yields over £7,000,000, or thirteen per cent of the total. The total expenditures for local purposes in 1890 were returned at £67,000,000; the difference between local expenditures and receipts being made up by contributions or grants from the inland revenue department of the kingdom and by municipal loans. The aggregate *local* debt of the kingdom is about one third of the national debt, and has been mainly incurred for municipal and urban improvements, such as water and gas supply, markets, tramways, parks, libraries, public baths, wash houses, drainage, and other improvements. The purposes for which the proceeds of local taxes are expended in the United Kingdom are mainly for poor relief, gas and water supply, schools, police, asylums, etc. In a report made to the British Association for the Advancement of Science in 1870 by Mr. Stanley Jevons, it was stated that the methods by which the local taxes of the kingdom were then levied were substantially according to an act passed in the reign of Elizabeth.

POPULAR THEORY OF TAXATION IN THE UNITED STATES STATED AND EXAMINED.—The general idea which constitutes the basis of the system of State or local taxation mainly recognized in the United States (though not in other countries), and generally known and designated as "*the general property tax*," is founded on the assumption that, in order to tax equitably, it is necessary to tax everything; the term *everything* being at the same time used in a sense so indefinite as to embrace not merely things in the nature of physical actualities other than persons, but also persons, incomes, rights, representatives of property, titles, trusts, conclusions of law, debts, and in short any act of assessing capable of resulting in the obtaining of revenue. As a logical consequence of this idea, the exemption of anything from taxation is furthermore held to be not only impolitic, but unjust, and if made necessary by circumstances, as something to be regretted.

The general property tax for general State purposes exists in all but four of the States of the Federal Union—Delaware, New Jersey, Pennsylvania, and Wisconsin. In Delaware there has been no property tax since 1877, as its expenses are defrayed mainly by licenses and taxes on railroads. In New Jersey there is only a school tax on property, but no property tax for general State purposes. In Pennsylvania the State tax is levied only on personal property. In Wisconsin the so-called State tax is levied only to defray the interest on the debt, and for the purpose of contributing to the university (one eighth mill tax), schools (one mill tax), and expenditures on account of the insane. But there is no property tax for general purposes. In addition to these four cases a property tax is levied in Vermont only in case the corporation taxes do not suffice to pay the entire expenses of the State (Seligman, Financial Statistics of the American Commonwealths, 1889).*

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* The statutes of Massachusetts enacted for making this system of taxation effective, and which have been substantially adopted by most of the States of the Federal Union, thus specify the objects, persons, and property that shall be subject to taxation:

Equally popular and plausible is the argument by which this assumption, and the administrative system based upon it, is upheld and defended. "Is not all property," it is asked, "either directly or through its owner, protected by the state or sovereignty?" "Do not all persons owe allegiance to the state?" And if so, "why should not all persons and property contribute to the requirements of the state for revenue in proportion to their ability?"

But, popular and plausible as are the arguments and assumptions for such a system of taxation, which, in the case of the United States, has been made operative under State, municipal, and local governments over the persons, property, and business of over seventy millions of people, and fortified by a vast amount of adjudication, it will require but little investigation and analy-

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SECTION 1. A poll tax shall be assessed on every male inhabitant of the Commonwealth above the age of twenty years, whether a citizen of the United States or an alien.

SEC. 2. All property, real and personal, of the inhabitants of this State, not expressly exempted by law, shall be subject to taxation.

SEC. 3. Real estate, for the purpose of taxation, shall include all lands within this State and all buildings and other things erected on or affixed to the same.

SEC. 4. Personal estate shall, for the purposes of taxation, include goods, chattels, money, and effects, wherever they are, ships and vessels at home or abroad, money at interest, and other debts due the persons to be taxed more than they are indebted or pay interest for, but not including in such debts due any loan on mortgage of real estate, taxable as real estate, except the excess of such loan above the assessed value of the mortgaged real estate, public stocks and securities, bonds of all railways, including street railways, stocks in turnpikes, bridges, and moneyed corporations, within or without the State, the income from an annuity, from ships and vessels engaged in foreign carrying trade, and so much of the income from a profession, trade, or employment as exceeds the sum of two thousand dollars a year; but no income shall be taxed which is derived from property subject to taxation.

The statute exempts from taxation the property of the United States and of the State; of the literary, benevolent, charitable, and agricultural institutions or societies incorporated within the State; all property of the common school districts; the household furniture of every person not exceeding one thousand dollars in value, and wearing apparel; farmers' utensils, not exceeding three hundred dollars in value; houses of religious worship; mules, horses, and neat cattle less than a year old; swine and sheep less than six months old; and "the polls and estates of persons who by reason of age, infirmity, and poverty are unable to contribute fully to the public charges."

"No ship or vessel, unless actually engaged in foreign trade, or in part undergoing repairs, shall be deemed to be engaged in such trade."

The statutes of the State of New York to the same effect are more concise, but equally comprehensive. They provide:

1. "All lands and all personal estate within this State, whether owned by individuals or by corporations, shall be liable to taxation, subject to the exemption hereafter specified.

2. "The term 'personal estate' and 'personal property' shall be construed to include all household furniture, moneys, goods, chattels, debts due from solvent debtors, whether on account, contract, note, bond, or mortgage, public stocks and stocks in moneyed corporations; they shall also be construed to include such portion of the capital of incorporated companies, liable to taxation on their capital, as shall not be invested in real estate."

sis to satisfy any one who can divest himself from the influence of old prejudices of the truth of the following propositions: *First*, that the assumption that it is necessary to assess everything in order to tax equitably involves an impossibility, and therefore unavoidable inefficiency, injustice, and inequality in administration; *second*, that, as popularly used in respect to matters pertaining to taxation, the term *property* is made to apply equally to entities and to symbols or non-entities, which is in itself an absurdity; and, *finally*, that the outcome of all this is a system which powerfully contributes to arrest and hinder natural development, to corrupt society, and is without a parallel in any country claiming to be civilized. And, in illustration of this latter point, it may be added that, notwithstanding recent discussions and publications, this whole subject is yet so unfamiliar to the people of the United States that probably nine out of ten of its best-informed and collegiate educated citizens, and even members of the bar, take it for granted that the method of assessing and collecting taxes for local and municipal purposes is substantially the same all the world over; and would be greatly surprised to find on investigation that the American system is one of the things that is exclusively American and so little esteemed by the people of other countries as to be for such reasons strictly "non-exportable."

TAXATION OF REAL ESTATE.—Attention is first asked to the defects of this system in respect to the taxation of real property. Here everything, as the term implies, is real, tangible, visible; something which can not be concealed; something which can not, under any circumstances, be removed beyond the jurisdiction of the State, except by transfer to the Federal Government; something concerning which the laws and decisions of the courts harmonize rather than conflict. In the valuation of real property, furthermore, it is possible to apply such tests and verifications as will restrict the errors of estimate within comparatively narrow limits. It would also seem as if the law as it exists upon the statute books of most of the States was sufficiently clear and explicit in its declaration and mandate. Thus the language of the statute of the State of New York is as follows:

"All lands within this State, whether owned by individuals or corporations, shall be liable to taxation. The term 'land' shall be construed to include the land itself, all buildings, structures, substructures erected upon, under, or above, or affixed to the same; all wharfs and piers; all bridges; all telegraph lines; all surface, underground, or elevated railroads and the iron thereon; all mains, pipes, and tanks laid or placed in, upon, above, or under any public or private street or place; all trees and underwood growing upon land; and all mines, minerals, quarries, and fossils in and under the same."

In most of the States of the Federal Union the tax laws require that the assessment of all property shall be at its full and fair cash value; and the judicial authorities of the United States have furthermore held that the requirement of approximative equality inheres in the very nature of the power to tax, irrespective of any constitutional or statute provisions.

In the State of New York each assessor on the completion of his official labors subscribes an oath of which the following is the material portion:

"We do severally depose and swear that we have set down in the foregoing assessment roll all the real estate in ———, according to our best information, . . . and that we have estimated the value of said real estate at the sums which a majority of the assessors have decided to be *the full value thereof*." And the law further provides that "every assessor who shall willfully swear false in taking and subscribing said oath, shall be guilty of and liable to the penalties of willful and corrupt perjury."

It is difficult to see how language, other than this, could be made more clear and explicit; and it is accordingly evident that if the law fails in its execution, as it certainly does, the fault is not in the statute but in its administration.

Let us now see what are the acknowledged facts in respect to the valuation of real property in New York and other States where the observance of substantially like conditions are imperative.

In some instances in New York the valuation of real estate for taxation is reported as low as twenty per cent of its real value. In a majority of cases in the country the rate varies from twenty-five to thirty-five per cent, and rises in the cities to fifty and possibly sixty per cent of the maximum. In one case, mentioned in the report of the State assessors in 1879, two adjoining counties of the State made a difference of twenty thousand dollars per mile in assessing the same railroad. In short, there can not probably be found a single instance in the whole State, unless possibly in the case of certain unoccupied lands, the property of non-residents, where the law as respects the valuation of real property is fully complied with, and where the oaths of the assessors are not wholly inconsistent with the exact truth. The official reports of other States abound with like reports of flagrant inequalities in the assessment of real property. As a rule, where assessors are dependent for their tenure of office on political favoritism, there is no pretense, notwithstanding their oath, of complying with the law.*

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* "The strife between counties to reduce assessments has not ceased, and in all probability will not as long as assessors are elected, or selfishness be a passion in the human breast."—*Report of the California State Board for the Equalization of Taxes, 1885–'86.*

When, as is often the case, a State tax is apportioned to the several counties of the State, and by the counties to their respective towns, there arises a double competition between assessors of counties in the aggregate and of the towns for making the lowest possible valuation of property, especially real estate.

In a large number of States (twenty-one in 1890) an attempt has been made to correct the undervaluation of property rightfully subject to taxation by creating boards of equalization, with power to raise or lower the valuations of county officials, with a hope of securing substantial uniformity; but this measure has not been successful, and the most intelligent members of such boards have recorded their opinions that it is impossible under the present system to effect any just distribution of the incidence of taxation.

"SOME UNRECOGNIZED LAWS OF NATURE."[*]

By C. HANFORD HENDERSON.

IN Some Unrecognized Laws of Nature, Mr. Singer and Mr. Berens have restated the riddle of the universe, and have made a brave attempt to solve it.

It has not been the good fortune of modern science to give us a coherent philosophy of things so much as it has been to give us a very nice measurement of them. Its triumphs have been for the most part quantitative. "We have only so much science as we have mathematics." One might almost say that science has become a branch of applied mathematics. In the case of the luminiferous ether, and in some other departments of physical inquiry, one might even go a step further, and assert that science *is* mathematics, pure and simple, dealing only with signs and symbols, and quite unregardful of the realities of experience. Brilliant and successful as this treatment has been, it does not satisfy all the demands of the spirit. The old sense of wonder and inquiry is still unappeased. One is often tempted to stop in the midst of one's measuring rods and balances, and put again the old question, the eternal Why?

It is this sentiment which makes us turn with some eagerness to such a book as the one before us. It is an inquiry, not into the phenomena of Nature, but into their causes, and more particularly into the cause of gravitation. At the present time, we have no theory of gravitation. The several guesses that have been made at it, have never been taken seriously enough to merit the name of theory. With the strictly orthodox, indeed, the cause of gravitation is no longer open to discussion. It has been relegated once for all to the region of the unknowable. A book, therefore, which throughout five hundred pages not only proposes to discuss this forbidden problem, but also professes to solve it, will attract attention for its boldness, if for nothing else. One begins to read with large sense of expectation.

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[*] Some Unrecognized Laws of Nature: An Inquiry into the Causes of Physical Phenomena, with Especial Reference to Gravitation. By Ignatius Singer and Lewis H. Berens. Illustrated. New York: D. Appleton and Company, 1897. Pp. 511. Price, $2.50.

The volume is divided into four books, which deal respectively with methods of inquiry; with first principles; with phenomenology, or "the interconvertibility of forces"; and finally with gravitation. All the books seem to us of value. They have been arranged with considerable cleverness, for the effect is cumulative.

The first book is largely psychological. Its main content has to do with methods of inquiry and of verification, and with sources of error. It maintains, and we think very properly, that our greatest need at the present time is a revision of our conceptions rather than any further confirmation of our observational or experimental data. In all cases the causes of phenomena are inferential, and are necessarily colored by our prior conceptions along the same lines of inquiry. Our stock in trade, when we come to philosophize, is simply the report of our own imperfect senses, helped or hindered, as the case may be, by our equally imperfect reasoning. The same facts may come into different minds, but they have far from equivalent values. It is comparatively easy to agree about the facts, but far from easy to agree about their interpretation. The interpretation is necessarily subjective, and is conditioned by many factors outside the phenomena themselves. Remembering this, one will be disposed to agree with the authors that apparent absurdity is not a legitimate refutation of any new and strange theory. It is only the absence of similar conceptions that makes the new view absurd. Nor does the correspondence of any theoretical view with prior conceptions offer the least confirmation of the view itself. Its agreement with preconceived ideas may prevent its seeming absurd, but does not prevent its being untrue. The so-called "confirmations" of philosophy and science will always bear re-examination, indeed demand such periodical re-examination, and the more so in proportion to their seeming certainty. The shores of the ocean of truth are thickly strewn with the wrecks of many a fair theory, as beloved in its day as the most cherished beliefs of our own day. Equally true is it that agreement between phenomena and theory, however perfect it may be, is not confirmation, for it is to be remembered that the theory itself was deduced from these very phenomena. The argument that such agreement constitutes proof is very plain reasoning in a circle—from which Heaven defend us all, and particularly our neighbor! The only evidence of this sort that is confirmatory must be *a posteriori*. If, from the consideration of things in general, a universal principle is brought to light, then the agreement of subsequently discovered or subsequently considered phenomena with this principle is strong evidence in favor of the probable truth of the principle itself. These considerations apply nowhere perhaps with greater force than in the investigation of gravitation. The problem is practically where Newton left it, unless indeed it has been rendered even more difficult by our inheritance of debarring ideas. The concluding chapter of the first book is wisely given to a psychological study of the current view of gravitation. The basic principle is not far to seek. It lies in the doctrine that gravitation is proportional to mass, and that mass is constant. With this conception firmly fixed in the mind, the interpretation of the phenomena of gravitation becomes a foregone conclusion. Yet the present authors show that this conception is far from being a necessary deduction from the facts of gravitation, is indeed probably a false deduction. Their experiments and reasoning lead them to believe, and the belief is supported by other observers, that either mass is not constant, or else that gravitation depends upon other factors than simple mass and distance. This alternative, however, as we shall see, is merely verbal.

Many of the psychological considerations in this first book are very obvious, yet they are none the less necessary, and we commend most highly the skillful vestibule which Mr. Singer and Mr. Berens have constructed to their new Temple of Truth.

The second book has to do with first principles. These the authors find to be four—persistence, resistance, reciprocity, and equalization. The four primary principles represented by these terms are at the basis of the whole work, and of their truth and adequacy the authors express themselves as having no misgivings whatever. They believe that the entire phenomena of the visible universe can be explained by referring them to these principles.

The principle of persistence grows out of a consideration of Newton's first law of motion: "Every body perseveres in its state of rest, or of uniform motion in a right line, unless it is compelled to change that state by forces impressed thereon." This is, of course, only the principle of inertia, which is simply another, and it has always seemed to us an unnecessary, statement of the principle of causation. Nothing happens without a cause. It is perhaps well to emphasize this principle when fighting superstitions and other hobgoblins; but in an intelligent world it may be taken for granted as one of those primary conditions of thought which need neither statement nor discussion. The habit of speaking of inertia as if it were a "property" of matter, and the use made of it in current mechanics, has long seemed to us mischievous. The present authors modify this law to read, "All matter tends to persevere in whatever state it may happen to be and to resist change." In this form the law is more catholic. By persistence the authors mean "the tendency of all matter to remain in any given state, even after the conditions are altered (i. e., a quality), while the term *resistance* is used to denote the *intensity* of this persistence (i. e., a quantity)." The gain is not simply one of terminology. It is a real gain, since it allows us to substitute a simple idea, that of relative persistence or resistance, for the somewhat complex and dissimilar ideas represented by such terms as impact, inertia, latency, conductivity, charge, etc.

The principle of reciprocity is founded on another dictum of Newton's, that "all reactions are mutual and are directed to contrary parts." This means very simply that every change involves at least two bodies, and that no body *acts upon* another, but rather that two or more bodies *react with* one another. This follows, indeed, from the principle of persistence. Since a change of state in any body can be brought about by external agencies only, it must follow that the persistence of this body can only be overcome by the expenditure of a certain amount of resistance on the part of the second or reacting body, and a corresponding change in its own state.

The two corollaries growing out of this law are also very important:

"1. Bodies can react with each other only when there is a difference of state in respect of any quality or tendency; and—

"2. The extent or intensity of the reaction will be proportional to this difference, and will cease altogether when relative equalization has been reached."

This second corollary really involves the fourth primary principle, that of equalization, in virtue of which all bodies tend to come to a common state, and the drama of the universe, the flux and flow of things, goes on eternally. It might at first seem that with the operation of this principle of equalization the universe would at last, like a spent clock, run down and stop. Such a view has indeed found expression in that modern and now famous doctrine, the dissipation of energy. A universe completely run down, a dead uniformity of condition, are among the striking spectacles of modern scientific speculation. It is not that we see any loss of action in the cosmic drama. On the contrary, it goes on unceasingly. It is only that a limited conception of the principle of equalization requires such ultimate uniformity. But there is another element that must needs be taken into consideration. The establishment of relative equilibrium between any two bodies would at once disturb the equilibrium existing between them and other bodies, and so tend to produce an unending series of readjustments. Furthermore, equalization with respect to any one quality or tendency does not mean equalization with respect to all. We have thus a twofold source of variation, and the conception of eternal change becomes at once less impossible than the conception of eternal rest. In addition, the doctrine of the dissipation of energy involves a fatal contradiction. If the world be running down by the conversion of all available energy into heat, how comes it about that the universe is at the same time cooling off by the loss of heat? The answer that the heat energy is being transferred to the ether is not satisfying, and it is particularly unsatisfying if one does not believe in the ether. An examination of the phenomena would lead one to the very contrary conclusion—that the world machine is not running down and that the universe is not cooling off.

The third book, on phenomenology, starts out with the denial of "force" and "energy" as separate physical entities, and seeks to find an explanation of acceleration and retardation, heat and molecular reaction, electricity and magnetism, conduction and induction, in terms of persistence, resistance, reciprocity, and equalization. Energy is regarded not as a cause of phenomena, but as a result, while "force" is dismissed as a metaphysical pitfall which has already claimed too many victims. The attempt is necessarily somewhat lengthy (it occupies two hundred pages), and the more so since the milk of human kindness in these two writers has not yet been condensed, but in the main it is a very successful attempt. It proceeds upon the true scientific principle —the search for similarities rather than for differences.

The same book also takes up the much-discussed question of action at a distance. We all remember Newton's words: "That gravitation should be innate, inherent, and essential to matter, so that one body may act on another at a distance through a vacuum without the mediation of anything else, by and through which their action and force may be conveyed from one to another, is to me so great an absurdity that I believe no man who in philosophical matters has a competent faculty of thinking can ever fall into it." But experience shows that equalization between two bodies in different states of excitation takes place the more readily in proportion as the intervening resistance is less. It is a natural inference, therefore, that the very most favorable condition for such equalization would be the absence of all resistance—that is, the absence of any intervening medium. Experiments with vacuum tubes confirm this inference. The more perfect the exhaustion the more perfect the transmission; and this is true not only of heat, light, and electricity, but as well of gravity itself, since bodies fall more readily *in vacuo* than in air. There is an important distinction between kinematic and dynamic reactions. The first, or primary reactions, not only can but always do take place at a distance, and in view of the undoubted fact any discussion of the possibility is idle in the extreme. But it is very different in the case of secondary or dynamic effects. There is, strictly speaking, no reaction between the bodies concerned. They have no attraction for each other. They merely happen to get in each other's way when one or both are undergoing some kinematic reaction. A falling body may meet a second body thrown upward, and the path of each will be notably altered, but the reaction will be purely dynamic, and as such absolutely dependent on contact. These secondary reactions happen to be the ones with which we are the more familiar and upon which we have allowed our minds to play the more freely. The old question, "Can a body act where it is not?" is only applicable to dynamic reactions, but is not at all pertinent in the discussion of kinematic reactions. In the first case, no one doubts the inability of a body to push or pull another without actual contact. In the second case, the facts leave no room for discussion.

The concluding book, on gravitation, is naturally the *pièce de résistance* of the whole, and seems to us of high interest and importance. The other books lead up to it very cleverly. Newton himself, as we have seen, had no theory of gravitation, or at least was extremely careful not to publish it if he ever had one. Later disciples, however, have been less cautious, and the Newtonian view has been erected into something of a theory. This assumes that all matter attracts all matter, and this quite independently of its state of excitation. The intensity of the attraction has been formulated in the well-known law that gravity is proportional to the mass and inversely proportional to the square of the distance. But mass, as Newton used the term, is synonymous with weight, and weight is simply the measure of gravity, so that this fine-sounding phrase amounts only to this, that gravity is proportional to gravity, a statement which can not be said to materially help on the cause of truth. The Newtonian view assumes the constancy of mass or weight, but does so without the least experimental verification, and indeed in the teeth of much contrary evidence. It is true that modern physicists distinguish between mass and weight, making the former term stand for amount of matter (whatever that may mean) and the latter for the measure of gravity. But in this sense mass is a purely metaphysical quantity.

Now, there are two classic experiments for determining the density of the earth that seem at first sight to establish the current view that all matter attracts all matter. These are the

Cavendish experiment, in which the attraction of lead balls of known mass is measured by means of a torsion balance, and so compared with the attraction of the earth; and the Schiehallion experiment, in which a plumb line is suspended near a mountain of known mass, and the deflection of the line from the vertical carefully measured. But both experiments proceed upon the assumption that all matter attracts, and prove nothing.

This review of the Newtonian conception serves as a preface to the authors' own theory, which is a direct outgrowth from the four primary principles deduced in an earlier book—persistence, resistance, reciprocity, and equalization. Briefly stated, their theory is that two bodies in different states of excitation and free to move will move toward each other, the intensity of attraction being proportional to the difference in the excitation. Bodies in the same state—that is, in equilibrium—have no attraction for one another, and there will be no gravitation manifested between them. This is a direct contradiction of the Newtonian position that gravitation is universal. The excitation of a body may be increased by heat, light, electricity, or magnetism, and consequently the attraction, weight, or mass may be changed by a change in the physical conditions. This has been repeatedly shown by experiment, but with the idea of the unchangeableness of gravity firmly fixed in the mind the results of the experiments have always been explained on other grounds. According to the new view, terrestrial gravitation is entirely due to the different states of excitation which prevail on the outside of the globe and on the inside, and notably to the difference in thermal condition. Heating a body on the surface of the earth ought, by lessening this difference, to reduce the attraction—that is to say, the weight—and such is actually the case. Every one who has worked in the laboratory knows that a hot platinum crucible weighs several milligrammes less than the same crucible when cold. This was formerly attributed to ascending currents of hot air, but the explanation no longer holds. These and other similar experiments have recently been repeated under conditions which do not admit the existence of convection currents, and the loss of weight is still observable.

With permission we quote from a letter recently received from Mr. Paul R. Heyl, of Philadelphia: "I have been making a curious experiment since I got back within reach of an analytical balance. I took a piece of three-quarter-inch glass tubing, sealed it at one end, and choked it slightly about one inch from the sealed end. In the lower chamber thus formed I placed dilute sulphuric acid, and dropped in a piece of solid caustic potash, which was arrested at the choke. I then sealed off the upper end of the tube about two inches above the choke. This arrangement I then packed in cotton in a light glass cylinder, one and three quarter inches diameter by six and a half inches high, and closed the mouth of the cylinder by a flat cork carefully paraffined so as to be air-tight. The apparatus was then placed upright on the balance and counterpoised carefully. The balance beam was then lowered and the apparatus removed from the pan, held inverted for a second or two, and replaced on the pan. On raising the beam and releasing the pans a distinct *loss of weight* made itself immediately apparent, some seven to nine scale divisions. (The apparatus weighed from one hundred and ten to one hundred and twenty grains.) After some three quarters of an hour the normal weight returned.

"This loss of weight could not be due to the fact that I was weighing a vessel filled with air partially rarefied by the heat produced, for both vessels were closed air-tight. Nor could it be due to currents of hot air rising (the usual explanation in text-books) for two reasons: first, because the loss of weight was immediate, and, owing to the cotton packing, the outside of the apparatus did not become perceptibly warm to the touch for three quarters of a minute, and never became more than barely warm; secondly, because the effect noticed was *too great* to have been produced by convection. . . . It would seem, then, that convection currents have been greatly overestimated, and that the loss of weight noticed in weighing hot bodies is in large part a true effect. Either mass is a function of temperature, or else (which is more probable) heat weakens gravitation just as it weakens magnetic attraction, only that the magnetic attraction does not come back when the steel cools."

Furthermore, the authors show that the combining weights of the elements vary with the temperature, and they record a series of very interesting experiments. When applied to celestial gravitation, to the motion of the earth and other planets, and to their apparent irregularities, the new theory leads to surprising conclusions. If it stand the test of a more widespread examination, it will entirely change our conception of astronomical physics, and make necessary a radically different cosmology. The speculations in this department, however, are put forward very tentatively, and more by way of suggestion than as settled convictions. It will be noticed here, as elsewhere throughout the book, that the observed phenomena of Nature are not called in question, but only our conceptions and interpretation of them.

In conclusion—and it is quite time that we should stop—we are disposed to believe that Mr. Singer's and Mr. Berens's book is destined to attract wide attention, perhaps to provoke warm controversy, and certainly to stimulate wholesome doubt and inquiry. It has a high value quite aside from whether one accepts the main conclusions or not, and we commend it to the serious consideration of those interested in the world-riddle. We can not forbear the remark, however, that even if we accept the conclusions, the cause of gravity is still to be sought. If we attribute it to the mutual attraction of bodies in different states of excitation, we have advanced a proximate cause for the attraction, but we have not explained why this is a cause or how it acts. We have but carried the inquiry one step further back.

> "Veil after veil will lift—but there must be
> Veil upon veil behind."

SCIENCE AT THE UNIVERSITY OF CHICAGO.

By Prof. FREDERICK STARR.

WHILE it is true that buildings do not constitute a university, it is also true that any description of science work at a university must give considerable prominence to buildings. Museums, laboratories, and observatories must be definitely constructed for the work which they are intended to perform; if there are peculiar and individual features in the instruction, some hint of these at least must appear in the structures in which this instruction is to be given. The buildings of the University of Chicago, with the exception of its astronomical observatories, are located upon a piece of ground in the southern part of the city, between Washington and Jackson Parks. These parks are connected by the Midway Plaisance, which, since the time of the World's Columbian Exposition, has been developed into one of the finest boulevards in the city. The property of the university fronts on this handsome driveway, and consists of four ordinary city blocks containing twenty acres. The portions of the streets intersecting this piece of ground have been vacated by the city, leaving the campus unbroken. Before a single building was erected the architect, Henry Ives Cobb, drew up a general study for the mass of constructions, which it is hoped will be finally erected. Ultimately the buildings will form a series continuous around the four sides of the campus, but with entrance ways at the middle of each side. In the great court thus inclosed will be separate buildings for museums, libraries, and laboratories. While some changes in the buildings thus planned have been necessitated, the idea in general has so far been carried out, and will be in the future. Many years must elapse before the plan is completely realized, but much has already been done. One temporary and sixteen permanent buildings have been erected;

of these seventeen buildings upon the campus, eight are specifically buildings for scientific purposes—Kent Chemical Laboratory, Ryerson Physical Laboratory, the four new Hull Biological Laboratories, Walker Museum, and Haskell Oriental Museum. All the buildings of the university are composed of the same material—a fine-grained gray freestone. Forming parts of one architectural design, all are built in one style, middle English Gothic. No two buildings are quite alike, but all are consistent, and produce, when taken together, a harmonious effect.

The Kent Chemical Laboratory was the first building devoted to science finished on the campus. It is the gift of Mr. Sidney A. Kent. In the hallway is a simple bronze portrait tablet bearing the inscription: "This building is dedicated to a fundamental science in the hope that it will be a foundation stone laid broad and deep for the temple of knowledge in which as we live we have life. —SIDNEY A. KENT."

FIG. 1.—PRESIDENT WILLIAM R. HARPER.

The arrangement and character of chemical laboratories are matters so definitely fixed by years of experience that few points of detail in reference to any one deserve mention. The Kent Laboratory is, however, well equipped for its work. In the basement are gas furnaces, seven in number, with air blasts for giving high temperatures. The ground floor contains lecture room, room for gas analysis, and rooms for advanced work in organic preparations. A chemical museum has been begun here which is to be greatly developed later. The second floor is devoted to research work and organic chemistry. Upon it also are the chemical library, combustion room, and sealed-tube room. Upon the third floor are the general laboratories for beginners, rooms for quantitative and qualitative analysis, dark room, etc. There are, of course, the usual store rooms and a balance room. In the building are six private laboratories for instructors, each completely fitted out. The head Professor in Chemistry, John Ulric Nef, has an excellent corps of helpers—Alexander Smith, Felix Lengfeld, Julius Stieglitz, and Richard S. Curtiss. The original work done by the force has been chiefly in the line of organic chemistry. Prof. Nef himself has conducted important investigations upon nitro-methane and the cyanides. Fulminic acid, discovered in 1820, was first satisfactorily analyzed by him. Among his important studies are those in the direction of ascertaining the composition of bivalent carbon. Prof. Smith has rendered important contributions to our knowledge of addition and condensation processes, while among the important works of Dr. Lengfeld and others of the staff are the obtaining of thiamines and other organic sulphur salts, studies upon rearrangement of molecules in compounds, hydrolitic dissociation of salts, and researches upon amydo-phosphoric acid, titanium and zirconium compounds. So far, however, nothing has been done in physical chemistry. No courses in that direction have been offered, and it is probable that none will be for some time to come. The department has no journal, but the results of the researches conducted here are published in the more important chemical periodicals, particularly in the American Chemical Journal, the Proceedings of the French and German Chemical Societies, Liebig's *Annalen*, and the *Compte Rendu*.

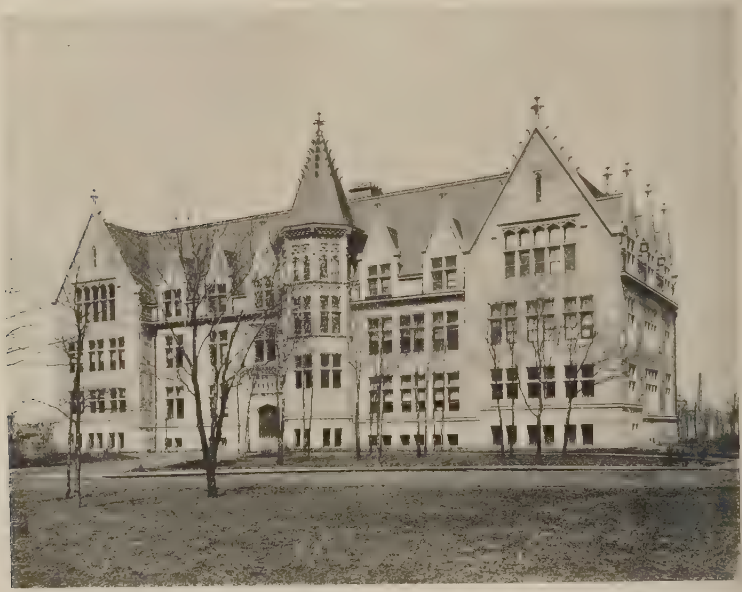

Fig. 2.—Kent Chemical Laboratory.

The Ryerson Physical Laboratory is unquestionably the best equipped and most handsomely finished building on the campus. Built by Mr. Martin A. Ryerson, of Chicago, to the memory of his father, Martin Ryerson, it was completed January 1, 1894. Externally individual and striking, its general character and style harmonize admirably with those of the other buildings upon the grounds. It is, however, far heavier and stronger in construction than the others; the interior wainscotings are in marble; the first-floor laboratories are provided with piers of masonry in addition to the heavy slate wall shelves which are found throughout the other portions of the building. The object of this heavy construction is to minimize the jars and disturbances from outside, which would otherwise seriously interfere with the delicate manipulations to be conducted, and the minute movements and vibrations to be studied. One striking constructional feature which adds largely to convenience is the presence of ducts and channels between walls and in the floors, so that pipes can be laid from any part of the building to any other without difficulty. Elementary students work upon the third floor, senior college students on the second, while the first floor is devoted to research work. The more notable features of the department's work are naturally upon this floor. The machine shop, under the direction of an expert mechanic with two trained men for helpers, allows the manufacture on the ground, under the eye of the investigator, of instruments needed in pursuing any study. This shop is fitted up with all needed machinery, supplied with power, and has connected with it a fully stocked supply room. Adjoining it is a students' work-

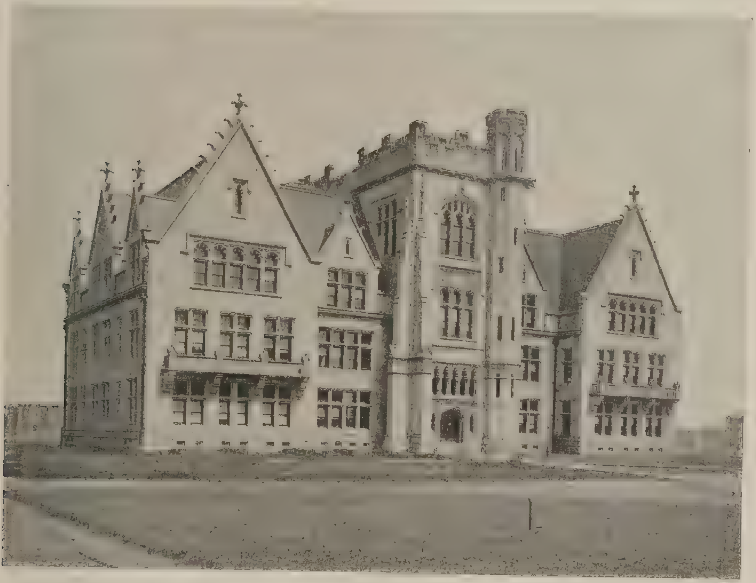

Fig. 3.—Ryerson Physical Laboratory.

shop, where one pursuing special lines may make up his own instruments, construct his own machines, or devise models to be used as patterns in the machine shop proper. The power for the building is furnished by three dynamos and an engine located in the basement. An air compressor and a vacuum pump form part of the outfit. The laboratories are large, intended for several students working together, or small, for individual workers. At the present time, students are pursuing investigations upon the mechanical equivalent of heat and the coefficient of viscosity of a liquid. There are eight or ten of these individual laboratories for single students, each supplied with all needed facilities. Every laboratory room, large or small, is supplied with gas for light and fuel, electricity for light and power, water, compressed air, and vacuum pipes. In one of the two constant temperature rooms is a highly interesting piece of apparatus conceived by Prof. Michelson and perfected by Prof. Michelson and Prof. Stratton. Its purpose is the direct production of standards of length. The principle involved is the determination of the length of the metre in waves of light. This determination was first made by Prof. Michelson, whose original investigation was published by the Bureau Internationale des Poids et Mesures, at Paris. The instrument produces light waves, from a given substance, of known length, and then mechanically lays off standards of length, up to two decimetres, in waves of light. Another notably interesting piece of apparatus constructed by Prof. Michelson and Prof. Stratton is a *harmonic analyzer*, which has cost two years of work. A first pattern was quite fully developed, only to be abandoned for the design shown in the illustration on next page. The purpose of the apparatus is the analysis and synthesis of any harmonic curve (Fourier's series), provided not more than eighty elements enter into it. Every one knows the vast use made to-day of traced curves in all branches of science. These curves are frequently resultants and combinations of two or more simple curves. It is a matter of difficulty to recognize and separate the elements thus combined. The machine in question enables the

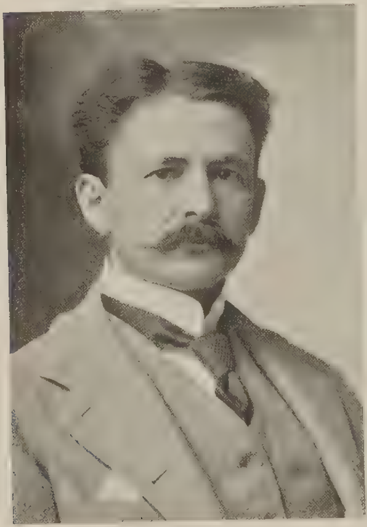

Fig. 4.—Prof. A. A. Michelson.

investigator to effect this decomposition and to prove it by mechanically reproducing the curve in question through combinations of the elements involved. The best way of showing the amount and character of the work done in this physical laboratory is to present a list of the researches completed or in progress during the year:

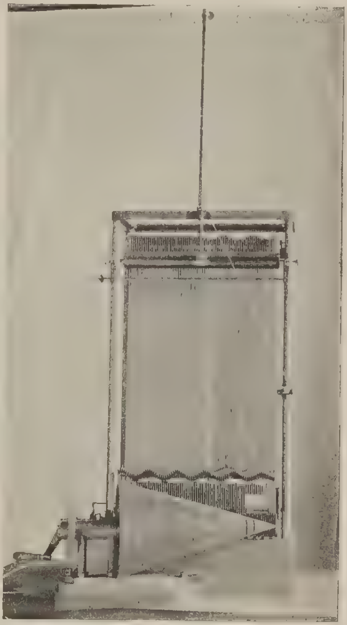

Fig. 5.—Harmonic Analyzer.

Researches Completed or in Progress during the Year.—(1) Relative Motion of the Earth and Ether—Head Professor Michelson; (2) A New Harmonic Analyzer—Head Professor Michelson and Associate Professor Stratton; (3) Production of Standards of Length by Means of Light Waves—Head Professor Michelson and Associate Professor Stratton; (4) Attempt to Measure the Superior Limit to the Size of Molecules by Capillarity—Head Professor Michelson and Associate Professor Stratton; (6) Deposition of Metals in High Vacua by the Electric Discharge—Associate Professor Stratton and Dr. Mann; (7) Study of Electric Waves by Means of the Interferometer—Mr. Hull; (8) Coefficient of Viscosity—Mr. Johonnott; (9) Resistance of Thin Metal Films—Miss Isabelle Stone; (10) Mechanical Equivalent of Heat—Mr. Smith; (11) Application of Interference Methods to Spectroscopic Measurements—Mr. Rice; (12) Velocity of Cathode Rays—Mr. Morrison.

One of the most thoroughly organized scientific departments in the university is that of geology, under the direction of Prof. Thomas C. Chamberlain, who has associated with him seven helpers. Perhaps nowhere in America is this work so carefully divided. The broad way in which it is treated at the University of Chicago is indicated by the list of workers: In geology proper, Profs. Chamberlain, Salisbury, and Van Hise lay general foundations; Farrington in mineralogy, Iddings in petrography, Salisbury in physiography and geography, Weller in paleontology, Holmes in anthropic and graphic geology, and Penrose in economic geology form a strong corps of specialists. The department aims at systematic training in its subject, either in contributing to a liberal education, or in preparing for professional and investigative work. The work is adaptable, ranging from undergraduate courses of the most elementary kind to the highest lines of seminar and field study. One feature demanding specific mention is the concentration of field work. While local field work is done in connection with the several classes, it is considered incidental; field work pure and simple is concentrated in consecutive and exclusive field investigation during the second term of the summer quarter. At that time the class is systematically organized and held constantly at work under the direction of an experienced field geologist. In all courses, whether in class room, seminar, or field, prominence is given to principles and working methods; special emphasis is laid on the philosophic phases of the subjects discussed; much attention is given to the treatment from historic and genetic points of view. Constantly and always the effort is to bring the student into relation with the living questions of the science, and to make him feel it as a growing body of truth. In connection with the department the Journal of Geology is conducted. It is a semiquarterly magazine, the actual editorship of which rests upon the geological faculty; the associate editorship is made up of the leading geologists of America and Europe. The important papers in its pages are mostly concerned with the present problems of the science. Among its most striking and valuable features are its Studies for Students, which are intended for advanced workers, and are full of the most important suggestions and help.

Fig. 6.—Prof. Thomas C. Chamberlain.

The department of geology is housed in the Walker Museum, a three-story and basement building donated by Mr. George C. Walker. The policy of the university is not in the direction of gathering great museum collections in any line. The Field Columbian Museum, so promisingly started soon after the World's Columbian Exposition, is located near the university. Fully organized, it is being systematically developed in every line of science. Its proximity renders the gathering of great collections at the university unnecessary, as students have special facilities furnished them by the museum. Collections, then, at the university will be chiefly formed with reference to their actual teaching value. The ground floor of Walker Museum is devoted to collections in mineralogy and geology, and the Ryerson collection of Mexican antiquities; the second floor is given up to the work of the department of geology, as already outlined; the third floor is chiefly devoted to work in anthropology. While the collections in geology present little of striking interest, they include the great series of fossils brought together by the late Prof. U. P. James, of Cincinnati, famous in American paleontology, containing great numbers of important specimens, and a particularly complete presentation of the fossils of the Cincinnati group (Lower Silurian). As stated, the work in anthropology is located on the third floor of the Walker Museum. It is fair to claim that at no other American institution is instruction work in anthropology so definite and at the same time so comprehensive, some eleven different courses in somatology, ethnology, and archæology being offered. Part of the space occupied is set aside for laboratory work. The instrumental equipment is nearly complete, although the material upon which to work is inadequate.

Fig. 7.—Walker Museum.

The charts and diagrams prepared by Dr. Boaz in connection with the World's Columbian Exposition, representing an enormous amount of investigation upon native American tribes and presenting it in graphic form, are the property of the university, having been originally drawn up at its expense; they form valuable aid to class and laboratory work. While not boasting a museum, the department has a considerable amount of material of its own from New Mexican Pueblos, Mexico, and Peru; it also has the use of loan collections of objects from Mexico, the Aleutian Islands, the Utah cliff-dwellers, Japan, etc. The most important of these loans is the Ryerson collection from Mexico—a large series of antiquities gathered by Señor Abadiano, and forming an excellent general representation of Mexican archæology. No journal of anthropology is published, but a series of Bulletins has been started. These will be octavo publications in pamphlet form, presenting new material or results of investigations by instructors or advanced students in the science. Two have already been published, dealing with points of Mexican archæology.

The Hull Biological Laboratories are the newest buildings upon the grounds. They are the gifts of Miss Helen Culver, and are named in memory of her uncle, Charles J. Hull. They form a group of four buildings arranged with an inclosed court. The buildings are grouped into two pairs, the members of which are connected by covered passageways or cloisters. Biology and Botany are thus united, and Anatomy and Physiology. The Biological and Anatomical Laboratories are at the front of the group and are connected by a short passage surrounded by a rather striking entrance way. The four buildings themselves, while conforming in style to the rest of the university structures, have been erected with special reference to their intended use, and neither space nor light has been sacrificed to the demands of Gothic decoration. In the center of the rectangular area surrounded by these buildings it is planned to have a pond of water of considerable size for supplying material in the direction of pond life. The Zoölogical Laboratory is under the direction of Head Professor C. O. Whitman, and consists of four floors and basement. Connected with the latter is a greenhouse arranged for supplying light and dark conditions, also rooms for animals in captivity, and various workshops. On the first floor is the general laboratory for elementary students, the general biological library, and a museum of illustrative series of life forms. The remaining floors are given up to suites of rooms for the head professor and his assistants, and to research laboratories. When the university was founded, Prof. Whitman brought with him a force of instructors and advanced workers from Clark University, at which institution he had developed the work in zoology to remarkable completeness. The work begun at Worcester has been prosecuted at Chicago with diligence. Among the important researches here conducted by Dr. Whitman and by his helpers, William M. Wheeler, Edwin O. Jordan, Sho Watase, and others, are contributions to annelid morphology, molluscan morphology and structure, and the development of arthropods and invertebrates. Important work in the line of cellular biology has also been done. An investigation now being conducted by Prof. Whitman himself will be of popular interest as well as of scientific importance—a study in pigeons. Prof. Whitman is crossing wild forms and conducting experiments upon various species in captivity; a wide range of forms is used, includ-

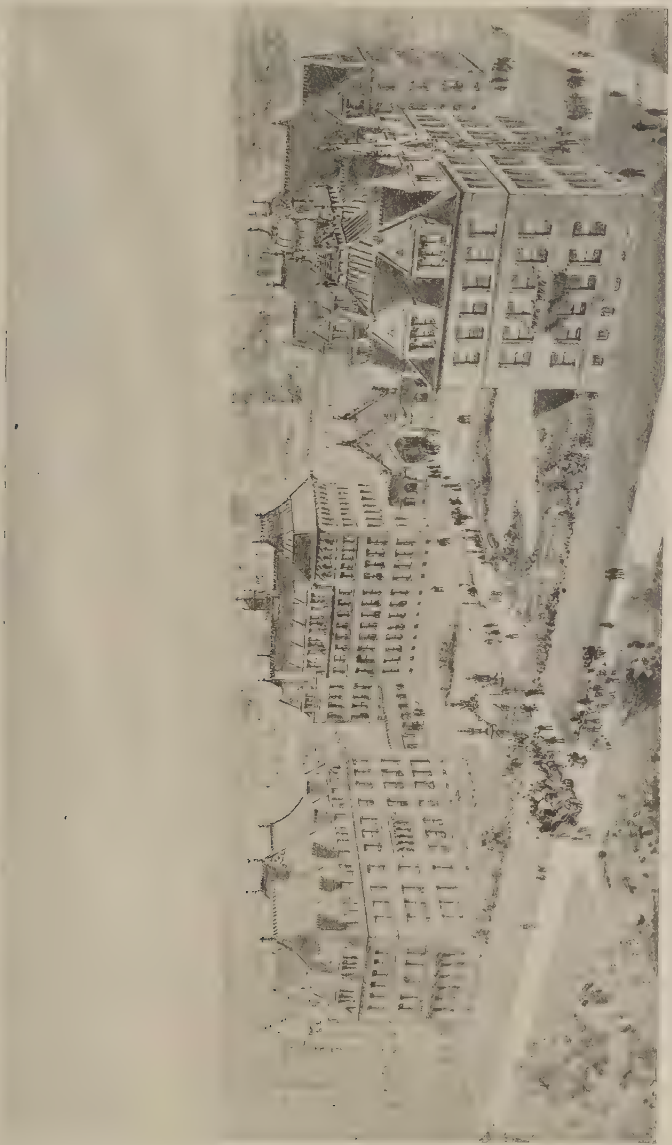

Fig. 8.—Hull Biological Laboratories.

ing species from Australia, Japan, South America, and other parts of the world. The east end of the fourth floor of the zoölogical building is devoted to the work in bacteriology. Prof. Jordan, who conducts this work, has a large laboratory and several smaller individual laboratories equipped with steam sterilizers, hot-air sterilizers, autoclavs, incubators, refrigerators, and all other necessary apparatus for culture and study of pathogenic bacteria and other germs. In connection with this work a Bacteriological Journal Club has been organized for reading and discussing the current literature of the field. On this floor, also for the present, are the quarters of Dr. Baur, Professor of Vertebrate Paleontology. The Department of Vertebrate Paleontology is under the direction of Prof. G. Baur. Before coming to the university Dr. Baur worked at Munich and afterward assisted Prof. O. C. Marsh at Yale. In 1891 he had charge of the Salisbury Expedition to the Galapagos Islands. His work at the university began at the founding of the institution in 1892. His courses cover vertebrate zoölogy and paleontology. Special reference is given to the great problems in taxonomy, distribution, and phylogeny. There are extensive collections for practical study from the South Dakota Miocene, the Wyoming Laramie, Kansas Cretaceous, and Texas Permian. No reference to Prof. Whitman's work would be complete which omitted the Marine Biological Laboratory and the Journal of Morphology, although neither is directly connected with the University of Chicago. The Marine Biological Laboratory at Woods Holl, Mass., is thoroughly and favorably known. Dr. Whitman is the director and has been indefatigable in its development. The work done there during the summer months is of the best. Students work in all grades, from elementary class work to the most advanced original research. Besides the laboratory work, which is of course the chief feature, series of lectures more or less popular but thoroughly scientific in character are given. The University of Chicago co-operates in these laboratories with the institutions of learning which have preceded her in their development. The Journal of Morphology, while not a university periodical, furnishes the natural medium of the original investigations there conducted. Dr. Whitman was connected with it before the university opened, and is still associated in its editorial management with Dr. Allis, of Milwaukee.

While the university has not yet a medical department, one of the new laboratories is arranged for anatomy. It is under the direction of H. H. Donaldson, Head Professor of Neurology. Among the features of the building is the handsome demonstration room. In this building also are two special lines of work of an interesting kind—viz., the work in neurology and that in experimental psychology. The former is, of course, in Prof. Donaldson's hands. The department is equipped with all the necessary illustrative apparatus—diagrams, models, etc.; the laboratory is supplied with needed material and appliances. The courses offered are intended (*a*) to furnish an exposition of the architecture and functions of the nervous system; and (*b*) to offer opportunity for the investigation of new problems and critical discussion of current work in the subject. In the outline of courses reference is had to the importance of the anatomy and physiology of the nervous system to the student of medicine. Special study is attempted of the variations in intelligence correlated with the changes in the central nervous system (1) in the vertebrate series, (2) during the growth and development of any individual, and (3) as the consequence of disease or experimental injury; such variations have an importance which is psychological as well as biological. The study of the nervous system is capable of throwing light upon some of the questions of phylogeny, and emphasis is laid upon this fact.

Experimental psychology, which has assumed recently great prominence in the universities, is here in charge of Prof. James R. Angell. Two chief ideas are held constantly in view in the work: (*a*) to give thorough practical training for the carrying on of experimental investigation; (*b*) to directly conduct such investigation. The instrumental equipment is adequate, placing the university among the first half dozen in America. The new quarters in the Anatomical Laboratory furnish ample space for laboratory work, apparatus rooms, and lecturing. The relation between this work under Prof. Angell and neurology under Prof. Donaldson is naturally close, and the two work in harmony. In psychology proper no work in nervous anatomy is undertaken, but students are impressed with its importance and urged to pursue it in the other department. The nominal relation of the work is with the Department of Philosophy, and some of the results of research have appeared in the publication of the university entitled Contributions to Philosophy. The first number of this publication is, in fact, devoted to psychology. Among its contents the paper on Reaction Times is fundamental and perhaps the most thoroughgoing statement yet made in this direction, so far as the processes themselves are concerned. Much attention has been given to memory processes, especially the visual and auditory elements of such processes. The work upon simultaneous sensations—visual, auditory, tactile, electric—is perhaps the most careful yet made. The study of the psychology of attention has been much emphasized during the past year. An investigation, the results of which are just about to be published, upon the growth of habit is among the first on this subject to be pursued from the primarily experimental point.

Both in the thoroughness of its equipment and in the interest of the subjects to be studied no laboratory on the ground surpasses the physiological. It is probably the only building devoted entirely to this purpose in America, and in the completeness of its equipment it surpasses most if not all of the European institutions of its kind. It has the ordinary complement of lecture rooms, laboratories, libraries, and study rooms. One somewhat novel feature in the lecture room deserves notice. The space behind the professor's platform is occupied by blackboards, extending almost entirely across the whole side of the room. The black surfaces, however, are at two different levels, that directly behind the lecturer's desk being slightly higher than the other, permitting it thus to be rolled back in front of the other half, disclosing behind it a screen of ground glass for projection. The work of darkening and operating in projection is done in a small room behind this glass screen, thus preventing all noise and disturbance of the class in the manipulation. Certain peculiar features in the arrangement of the laboratory deserve special mention: (*a*) a greenhouse of fair size, divided into two sections, is intended for the rearing of insects and plants, supplying the opportunity for extended study of phenomena of life in the lower forms of animals and plants, for physiology can never be studied simply from animals, vital processes being comprehended only from a full survey of conditions found in all living things; (*b*) a large aquarium for sea life; the proper stocking of this will be a matter of time, but the keeping and observation of marine forms are important; (*c*) a cold storage room for the study of polar effects; (*d*) an arrangement of dark rooms with heliostat, prisms, etc., for studying the effect of monochromatic light upon living forms. The first of this series of rooms forms practically a vast spectroscope. The light is thrown from outside by a heliostat of the greatest perfectness of construction. It is received upon a battery of prisms, which can be controlled by connections in the next room. The light, when separated into rays of the various colors, is thrown through a slit in a connecting door upon the support on which rests the animal or plant under experimentation. This is in a little room so related both to the spectroscopic room and to the hinder and third room of the series that no unresolved light can gain access to it at any time unless desired. (*e*) There is also a room for the study of the influence of high temperatures. These five special features are both important and novel. In addition to them there are operating rooms, rooms for experiments in metabolism, physiology, chemistry, ordinary laboratory work, etc. The two rooms where higher animal forms—dogs, monkeys, rabbits, etc.—are kept in captivity are supplied with cages of the best construction, and are carefully arranged for light, ventilation, and cleansing. All the ordinary laboratory rooms are supplied with aquarium equipment. The two chief designs of the laboratory may be categorically expressed: (1) to provide material for the extension of physiological investigation to the whole animal kingdom and even to the plant world; (2) to provide opportunity for studying the effect of all environmental conditions singly upon living forms. The importance of these is manifest. Physiologists have been too much inclined to learn their lessons from man alone, or from man and a few of the higher mammals. Certain processes, however, absent or obscure in man, are present or better defined in some other forms. Phenomena vary with types: one is at its best in one species, another in another; a wide range, therefore, of forms is necessary. In studying the effects of environment it is desirable, so far as possible, to isolate the elements of which it is composed. It is an easy matter to attribute an effect to the wrong factor in the surroundings. The Physiological Laboratory is in a sense an expression of its head, Prof. Jacques Loeb. Dr. Loeb was trained in the most important laboratories of Europe, and his investigations therein were of extreme interest. His study of heliotropism demonstrated that the tendency of plants to turn sunward was the same thing as the impulse which drives the moth to the flame; that there is no more psychical activity in the latter than in the former. His later investigations into the mechanism of geotropism, or the tendency to turn or grow toward the earth, and other kindred phenomena, amplified and further illustrated these conclusions. His curious investigation into heteromorphosis—substitution of one organ by another, transformation of one organ into another—was really an outgrowth of these studies. The importance of the results of the whole series is illustrated in a recent article by Dr. Loeb upon egg structure and the heredity of instincts. Recognition that much of what has heretofore been considered psychical in instinct is merely the necessary result of chemical actions and the mechanical operations produced by them, given external combinations of conditions being present, greatly simplifies the conception of egg structure, and relieves us of some of the embarrassingly complicated conceptions in certain of Weismann's later theories.

The Botanical Laboratory, under Prof. Coulter's direct supervision, is the fourth of this striking cluster of buildings. The most notable feature is the greenhouse in the roof. From below it appears small, but it probably measures something like seventy by thirty feet. It serves two excellent ends: (*a*) it supplies material at every stage of growth for laboratory use; (*b*) it furnishes all kinds of conditions for experimentation. The arrangements for control in temperature and moisture are nearly perfect.

Tropical conditions are presented at the center; desert, arctic, and aquatic conditions are arranged for at other parts. Experiments are to be conducted to determine the effect of varying conditions upon organs. One of the principal subjects hitherto pursued in the field has been the determination of effects of varying environment. This field study is fundamental to, and directly suggests, the experimental work to be followed in the greenhouse. The building is supplied with an elevator which runs to the greenhouse, so that material may be taken down with a minimum of trouble to any floor where it is needed for laboratory work or class-room illustration. The upper floor of the laboratory is devoted to plant physiology. The professor has a suite of three private rooms—one his own office, one a herbarium and library, and one a laboratory. Similar suites of rooms are at the disposal of each of the teaching force. The largest laboratory on this floor is for general elementary work upon individual life processes. Smaller laboratory and research rooms for special and advanced students are numerous throughout the building. Everywhere the work tables are set near windows, and each is supplied independently with gas and water. The chemical laboratory, also on the upper floor, is admirably arranged. On the third floor the study of cryptogamic botany is pursued. The forms are studied (*a*) morphologically, (*b*) taxonomically. The space is divided between two instructors, one devoting himself to algæ and fungi, the other to mosses and ferns. Each of these teachers has the usual suite of rooms, while there are six absolutely independent private research rooms. The second floor is occupied by Dr. Coulter himself. Here is the seed-plant herbarium. There are three large rooms for herbarium or taxonomic work, also the library and reading room, club meeting room, and laboratory for advanced work upon seed plants. Upon the ground floor are two large laboratories crowded with students at elementary work. Their purposes are (*a*) elementary morphology, (*b*) ecology. In the present unsettled condition of the building those parts actually in use are overcrowded. One hundred and five students are daily at work in the various laboratories and research rooms. The Botanical Herbarium represents almost the whole collection work of Dr. Coulter. It contains all his monographic material and the type specimens of his Western flora. It was stocked up by Dr. Gray for the work on the Rocky Mountain flora, and is notably full and rich. The library presents two features of importance in research work: (1) remarkable richness in complete series of periodical and serial publications; (2) unusual fullness in the line of old taxonomic works. Most of these came to the university in the Calvary purchase. In the early days of the university it purchased a gigantic stock of books from a well-known

German second-hand dealer. In this vast mountain of printed matter a number of lines were particularly richly represented; among them was taxonomic botany, a surprising number of rare books turning up which Prof. Coulter had been watching for through years without succeeding in finding. In 1875, at Hanover College, the Botanical Gazette first saw light, and it has enjoyed continuous existence up to the present, always under Dr. Coulter's editorial supervision. At first a personal enterprise, it was taken over by the university in March, 1896. It is a monthly journal, the numbers comprising from eighty to one hundred and twenty pages, and has always been a favorite medium for the exchange of botanical ideas and for the publication of important papers. Notwithstanding the extensive arrangements for the study of botany made at the University of Chicago, Dr. Coulter writes: "But when all the space is used as planned, the demands for work in plant diseases, so extensively cultivated by the Government and at experiment stations; in economic botany, including the great field of forestry; in paleobotany, which is in sad need of being cultivated in a botanical atmosphere, are not met. It will be seen, therefore, that abundant as the space and the privileges are from a comparative standpoint, from the standpoint of the subject in relation to a great university the necessities are far greater."

While the work of the Departments of Sociology, Philology, and Philosophy perhaps deserves mention here, our aim is rather to present those lines of science which by instrumental equipment, museum collections, or rigidly scientific methods of instruction occur immediately to the mind upon the mention of the word science. It is hardly possible, however, for us to omit reference to the University School. Closely connected with the Department of Philosophy and under the same direction is the Department of Pedagogy. The work is both theory and method. To illustrate principles and to furnish opportunity for scientific study of a well-balanced curriculum in the earlier grades, a school is conducted. Something over thirty pupils are in attendance. Prof. Dewey's own statement regarding this school may well be quoted:

"The conception underlying the school is that of a laboratory; it bears the same relation to work in pedagogy that a laboratory bears to biology, physics, or chemistry. Like any such laboratory, it has two main purposes: (1) to exhibit, test, verify, and criticise theoretical statements and principles; (2) to add to the sum of facts and principles in its special line.

"As it is not the primary function of a laboratory to devise ways and means that can at once be put to practical use, so it is not the primary purpose of this school to devise methods with reference to their direct application in the graded school system.

It is the function of some schools to provide better teachers according to present standards; it is the function of others to create new standards and ideals, and thus to lead to a gradual change in conditions. If it is advisable to have smaller classes, more teachers, and a different working hypothesis than is at present the case in the public schools, there should be some institution to show this. This the school in question hopes to do, and, while it does not aim to be impractical, it does not aim primarily to be of such a character as to be immediately capable of translation into the public school.

"The hypothesis underlying this experiment is that of the school as a social institution. Education outside the school proceeds almost wholly through participation in the social or community life of the groups of which one is a member.

"The work here outlined is based on the assumption that the more formal education of the school does not depart from the same general course that the unconscious adjustment follows, but organizes it. The school is a special social community in which the too complex social environment is reduced and simplified; in which certain ideas and facts concerning this simplified social life are communicated to the child; in which, also, the child is called upon to undertake not all kinds of activity, but those specially selected on the ground of peculiar adaptation to the child."

The Haskell Oriental Museum is a three-story and basement building erected by Mrs. Caroline E. Haskell to the memory of her husband, Mr. Frederick Haskell. At the present time the second floor only is devoted to museum collections, but in the near future the whole space of the building will be so occupied. While the most extensive collections are in Egyptology, there are other series. A biblical collection has been begun; the Assyrian collection consists almost wholly of reproductions; the Buckley collection, illustrating the religions of Japan—Shinto and Buddhism—was secured by Dr. Edmund Buckley during a long residence in the Island Empire. This last deserves more than passing notice; while rich on the Buddhistic side, it is notable in Shinto. Shinto is a religion of a barbaric people held by a nation in full civilization; it is profoundly curious and interesting. There is probably nowhere so complete an exhibition of this native Japanese cult as in Dr. Buckley's collection, containing as it does sacred objects, votive offerings, scriptures, prayers, and cult implements. Dr. James H. Breasted is in charge of the work in Egyptology and brings to it an unusual enthusiasm. Recently the Chicago Society of Egyptian Research has been established, with a threefold object: (1) to assist in Egyptian excavation, (2) to bring to Chicago a just share of antiquities so discovered, and (3) to inform its members concerning the ancient civilization which these discoveries represent. The society was organized March 13, 1897, and is the outgrowth of two movements—the interest shown for some years by Mrs. Charles L. Hutchinson in securing subscriptions to the Egyptian Exploration Fund, and the later interest shown in the same by the Woman's Club. The society raises a considerable sum yearly, one half of which is given to the Exploration Fund, and the balance to the Egyptian Research Account, both of which are practically under Mr. W. Flinders Petrie's direction. Mr. Petrie has sent a considerable quantity of valuable, recently discovered material to the university, which, with the material already secured by Dr. Breasted, forms the Egyptian collection of the Haskell Museum. It comprises a representative series of pottery and household utensils, chess board and men, matrices or molds for ornaments and charms, talismans, gods, rings, pendants, etc. A full series of the pottery of the remarkable people discovered by Mr. Petrie opposite Koptos in the winter of 1894–'95 has been sent by that explorer. Among recent additions of interest from the same investigator are many of value because bearing royal names; thus, a sandstone tablet shows Thothmes IV worshiping Amon, with a line of inscription commemorating his overthrow of the barbarians. Several sun-dried bricks are stamped with royal names, and a fine series of jar tops are signed and sealed. Some pieces of gold foil also bear signatures. There is some good carved work in stone, among other pieces a magnificent bust of the goddess Sekhmet. Of wooden tablets, two bearing scenes representing the deceased before Osiris were exquisitely done. In the last shipment received was a fine lot from the old empire representing the fifth

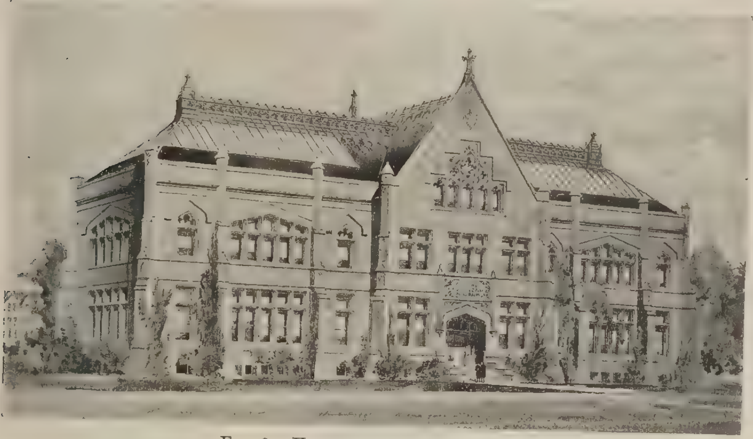

Fig. 9.—Haskell Oriental Museum.

dynasty; limestone portrait statues with the original colors still visible and bearing inscriptions; coffin and mummy of the lady, Mery; an inscribed wooden head rest; and a unique painted board with figures of servants cooking for the deceased. This work of collection so well begun will be prosecuted vigorously, and in time the university will possess a notable Egyptian museum. In one sense the Haskell Oriental Museum is the outgrowth of the Department of Comparative Religion, which is under the direction of Prof. George S. Goodspeed. Courses are offered by Prof. Goodspeed and his helpers in a considerable range. The religions of China, Japan, India, ancient Persia, Greece, Rome, and northern Europe are studied historically and in the light of modern science. A unique feature connected with this department is the establishment of two lectureships on the Relations of Christianity to the other Religions. These lectureships were endowed by Mrs. Haskell, and are known as the Haskell Lectures and the Barrows Lectures. The former are given yearly at the university, the latter are delivered in alternate years in cities of India. Both lectureships are held by Rev. John H. Barrows, President of the World's Parliament of Religions in 1893. The first course of Barrows Lectures was given last year in India, and created a considerable stir.

Presented last, from the fact that much of the work is done at other places than the university proper, is the Department of Astronomy. A small observatory on the campus supplies opportunity for elementary work in practical astronomy by undergraduate students. The Kenwood Observatory, situated in the city about one mile north from the campus, furnishes facilities for practical work by more advanced students in physical astronomy, practical astronomy, and astrophysics. Its astrophysical equipment is complete. The Yerkes Observatory is just being completed, and will soon be in operation. This, the gift of Charles T. Yerkes, is located about seventy miles from Chicago, at Williams Bay, Lake Geneva, Wisconsin. The site occupied comprises about fifty acres of timbered land. The buildings are located upon a gently sloping hill about two hundred feet above the level of the lake and twelve hundred feet above the sea. The place has been especially selected for freedom from dust and tremors. The building is T-shaped, the great dome being at the foot of the letter and the smaller domes at the other extremities, the latter being for sixteen-inch and twelve-inch telescopes. The greatest length of the building, which is from east to west, is three hundred feet. The central body contains library and lecture rooms, laboratories for physical, chemical, and photographic work, computing rooms, and offices. The building is of the best construction. The great telescope is the largest refracting telescope ever constructed, having a forty-inch objective made by Alvan Clark & Sons. The focal length of the instrument is sixty-four feet. The mounting is similar to that of the great Lick telescope, but is heavier, more rigid, and improved. One important advantage introduced for the first time in this mounting is the system of electric motors, by means of which the various motions are effected. By simply touching buttons upon a little keyboard the astronomer may produce any one of ten different results, changing the position of the instrument or of parts of the observatory itself. In this simple way the great instrument may be moved, the clock may be started or stopped, the shutter of the dome may be opened or closed, the dome itself may be revolved, or the floor may be made to rise and fall. The dome covering the telescope is about ninety feet in diameter, with an observing slit twelve feet wide extending from the horizon to beyond the zenith. Two spectroscopic attachments are connected with the great telescope: (*a*) a *spectroheliograph* for photographing the solar chromosphere, prominences, and faculæ by monochromatic light combined with a large solar spectroscope for photographic and visual study of solar phenomena; (*b*) a *stellar spectroscope* for photographic and visual investigation of stellar spectra, and determination of motion in the line of sight. The world has a right to expect results from such an instrumental equipment, and the Department of Astronomy has in view important researches. Among these are micrometrical measurement of double stars and

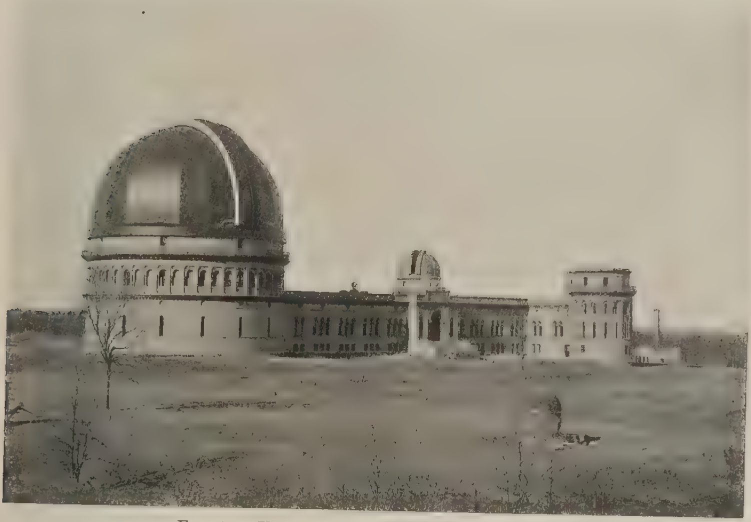

Fig. 10.—Yerkes Observatory, Lake Geneva.

faint nebulæ; observation of planets, satellites, and comets; photographic and spectroscopic investigation of conditions of the sun; researches on the spectra of fixed stars and nebulæ; motion of stars in the line of sight. The Yerkes Observatory will, of course, be used only by advanced students capable of undertaking important and original investigation. The ordinary instruction for undergraduates and elementary students will continue to be given in the city at the university itself and at Kenwood Observatory. It would be a mistake to imagine that up to the present time the university has made no contribution to astronomical science. Important studies have been conducted by Prof. Hale,

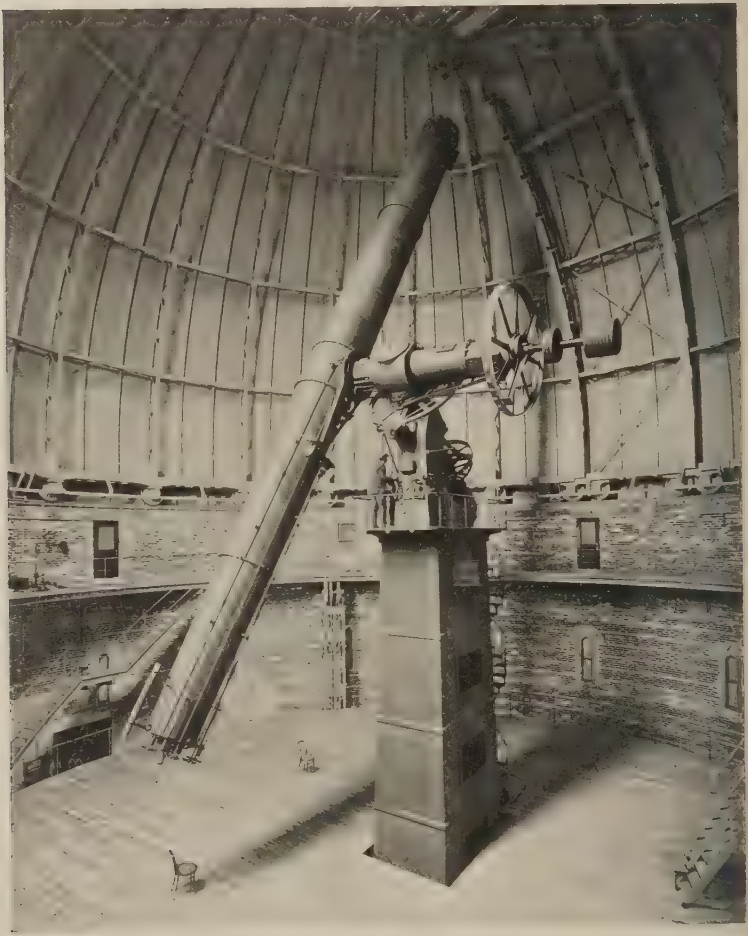

Fig. 11.—The Telescope, Yerkes Observatory.

Prof. Burnham, and Dr. See; and a journal of high value, the Astrophysical Journal is published through the University Press, under the editorship of Prof. George E. Hale, of the University of Chicago, and Prof. James E. Keeler, of the Allegheny Observatory. In its pages will be found many valuable observations and investigations conducted by the university force.

THE IDEA OF MURDER AMONG MEN AND ANIMALS.

By GUGLIELMO FERRERO.

WHOEVER has studied in its particulars the history of the past knows well that human ferocity is an unfathomable abyss. Who could enumerate all the means invented by men to exterminate each other in turn, from the spear and the yataghan to shrapnel, from hemlock to prussic acid, from Greek fire to dynamite? Were we to try and calculate, even roughly, the number of human beings who have died a violent death at the hands of their own kind, even during that period alone which has elapsed since the dawn of history, the total reached would be undoubtedly monstrous. Nor must we be blinded as to the feelings of our ancestors by the growth of a certain gentleness of manners which has for scarcely a century past been refining human society in Europe; one of our ancestors' chief amusements consisted in the destruction of other men—the extermination of other human beings. Homicide has been at all times, in all forms, and under all conditions, individual and collective, a fierce passion of the human race, a most common incident of everyday life, inspiring no one with any feeling of horror whatsoever. It is sufficient to recall the fact that among people who reached a noteworthy stage of civilization, such as the Romans, war, which is a systematic homicide, or, in other words, ferocity reduced to a science, could be regarded as a financial speculation and a perfectly legitimate one for the educated classes to engage in; and that what is called history is little more than an interminable series of murders, individual and collective, one more ferocious than the other.

The present age has witnessed so important an amelioration of habits that we are apt to forget that it is of very recent date, and to see in the ferocity displayed by our ancestors something contrary to human nature—so much so that we have come to stigmatize all actions of an excessively savage character as "inhuman" and "brutal." A closer analysis will, however, show that this is an illusion; inasmuch as murderous ferocity, by which I mean the passion for destroying life, would seem to be a characteristic peculiar to humanity, one which either does not exist in animals or has been observed to exist among them only in an infinitesimal degree.

This is one of the most obscure and difficult problems which we meet with in animal psychology. A large number of animals live, it is true, in a state of permanent warfare, killing and devouring each other in turns, but how far does this fact imply another—viz., that this internecine slaughter presupposes in animals a clear idea of death—of the extinction of life as the necessary consequence of their actions? How far are these acts of hostility determined by the intention of depriving another animal of life? In other words, have animals a distinct idea of life and death and of the means by which life may be destroyed?

Let us examine the animals which are considered to be the most ferocious among the mammals—viz., the feline tribe. It is well known that the lion, which attacks another animal in order to make a meal of him, almost always kills his prey by seizing it by the neck and crushing between his teeth the other's cervical vertebræ. Further, the lion's action in this maneuver is so certain that he generally kills the animal at the first attempt. Are we justified in inferring from this fact that the lion has a clear idea of life and death, and that he crunches between his teeth his adversary's vertebræ with the distinct idea of killing him, aware that by so doing he is depriving him of life? I do not think so. When he treats his prey thus he probably merely remembers from former experience that the animal will offer no further resistance and may therefore be devoured in peace—a far simpler idea than those complex differentiated notions implied in a perception of the difference between life and death.

That, as a matter of fact, the lion does not possess the aforesaid idea of life as distinguished from death, and of the possibility of inflicting the latter, may be seen from his behavior when he springs upon a hunter who has wounded him—not to devour the hunter but in self-defense. If he had a distinct idea of life and death and of the means at his disposal of inflicting death, this is surely the occasion in which he should display it. On the contrary, however, it usually happens that when a lion springs upon a hunter that has wounded him and knocks him down, he bites him two or three times, wherever he can; and, having thus satisfied his rage, he goes away, taking no further heed of his enemy, whose ultimate fate depends upon what part of the body the lion has bitten him. If the bite has injured some vital organ, the unfortunate hunter succumbs to his injuries; but if it has been inflicted upon some secondary organ only, he may escape from a most critical position with comparatively little damage. Hence, although the lion's claws are as keen as razors and his teeth little better than daggers of the most terrible kind, hundreds do frequently escape from conflict with a lion, sometimes almost unwounded. Meunier, one of the most illustrious French observers of animal psychology, narrates how a certain man named Botta was once knocked down by a lion, kept in a perilous position for some time, bruised all over, and badly bitten in the arm, after which the lion went away, leaving the man very seriously but not dangerously wounded. Delagorgue cites a lion hunter who found himself in the same predicament twice within seven years after having fired at a lion. The first time the lion contented himself with fracturing both the hunter's arms; the second time it inflicted six bites and clawed him in several parts of the body, and on neither occasion did it proceed to further reprisals. Another man, Vermaes by name, a farmer living near the source of the Mooi, a tributary of the Tanguela, in Natal, one evening espied a lioness assailing his cattle. Directly he saw her he fired and hit her; but the animal sprang upon him and knocked him down. The man afterward described how he had felt: his ears stunned by the animal's hoarse roars, how he had seen two jaws armed with long white teeth opened wide above him; how he had felt the two sides of his chest being crunched together all the way down; after that, nothing more. He was picked up bleeding from this one bite, after giving which the lioness had departed.

These facts seem to show that the lion is not consciously aware of his power of destroying the life of another living creature. He springs upon his enemy in order to wreak his anger, and bites instinctively, but not to kill him. Hence he bites at random wherever chance offers, without allowing himself to be guided by previous experience, which would have shown him that certain bites given in a certain way may cause death; and as soon as he has satisfied the need he feels of relieving his rage by biting he goes away.

The lion, then, is a dangerous beast, not because he is ferocious in the sense that he enjoys the sensation of successful slaughter—he has not reached the idea of death, and hence can not realize his vast power to inflict it; he is ferocious because he bites when infuriated, and because the bites of an animal so powerfully endowed by Nature are of terrible consequence. Hence it follows that when he strikes his prey so definitely on the neck before devouring it, he does so not with the distinct idea of killing it, but merely because experience has shown him that after having struck it in this particular way he can most easily devour it; and this fact also explains why he does not strike in the same way when he springs upon another creature, not for food, but in a fury of self-defense.

Let us now consider another species of animal, and one nearer to man—viz., the apes, more especially the strongest and most savage of their kind. Here, again, it is permissible to assume that no variety of ape has succeeded in forming a clear idea of death and of the means of inflicting it. Thus, if the gorilla were possessed of the idea of death, and the way in which his formidable arms can cause it, never would man escape from a struggle with such a creature; for, as Brehm points out, a single blow from the huge claw-armed foot of a gorilla can rip up a man, break open his chest, or cleave his skull. And yet many do escape from these encounters with the great simian, maimed and mutilated indeed, but with their lives. Brehm narrates that he has met in Africa with many such horribly mauled survivors. Now, it is evident that if so strong and formidable an animal—whose human foes are absolutely at his mercy, once they have discharged their firearms—frequently fails to kill them, it can only be because he strikes blindly under the influence of rage, without directing his blows in such a way as to indicate that he possesses any consciousness as to the spots in which the blows would produce the most vital effects. The gorilla, therefore, has no idea of death and of the means of inflicting it.

This view is strengthened by all we know concerning the conflicts which take place among the gorillas themselves. The male gorilla fights savagely in the mating season, and yet no one has ever found a dead gorilla which could possibly have perished in one of these skirmishes. On the other hand, gorillas have been seen bearing scars or jagged rents undoubtedly produced by the teeth of some rival in love, an obvious indication that in these conflicts the animals confine themselves to biting as chance directs, and that their frightful capacity for slaughter is not set in motion from any predetermined idea of destroying the life of an adversary.

The orang-outang likewise uses its teeth as sole weapon of offense and defense; and that also on impulse. "When it is wounded or pursued," says Brehm, "it can defend itself well; the hunter should then be on his guard. The animal's arms are strong, and its teeth most formidable; it can easily fracture a man's arm and its bites are horrible."

Let us follow the same author's description of a fight between a dog and a baboon, which is the largest simian after the orang-outang and the gorilla: "The dog follows its foe and endeavors to seize it; but the baboon suddenly turns and springs upon the dog with an appalling howl, grips it with all its claws at once on breast and throat, bites it deeply on those spots several times, rolls with it over and over on the ground, biting again and again, and at last leaves it prostrate, covered with wounds and blood. The baboon then makes for the rocks, uttering yells of victory absolutely diabolical." Here, too, it is evident that even the strongest baboon is not guided by the idea of destroying its adversary; it is not aware that by compressing the dog's throat it might strangle or suffocate him, that by biting in certain parts of the body it might cause him to bleed to death. It simply allows itself to be carried away by an impulse of fury, which is vented in bites and scratches—sometimes, it is true, of terrific violence—which, however, do not easily cause death, precisely because all these actions, however violent, are not co-ordinated in an end, viz., that of killing the adversary—by a clear idea of death and of the means of inflicting it.

I have cited the above examples to show that in one of the strongest felines and among the strongest and most intelligent of the anthropoid apes the existence of the idea of death and of the means of inflicting it can not be admitted, and that hence the slaughter of one of these animals by another, whether of its own or of another species, can never be the result of a conscious act of volition. In their struggles, both among themselves and with other creatures, their aim is never to kill, but merely to bite and claw; in short, to give vent to their internal rage by violent acts as impulse may direct. And if such acts do sometimes result in death, this fact must be regarded as essentially due to accident, and according as the wound happens to be inflicted, with more or less severity, upon a vital part of the body. But the capacity, predetermined by conscious will, to slay another creature of the same or of a different species seems to be non-existent; and hence all the ferocity of these animals is impulsive, the result of impetus, never a matter of reflection or of will; it is confined between narrow limits, in that it lacks that idea of the possibility of destroying the life of other creatures which has opened such a boundless horizon to the ferocity of the human race.

Can this generalization, which facts demonstrate to be true as regards the lion and some of the primates, be extended to the whole animal creation? To make a similar assertion would undoubtedly be rash; the facts which have been noted are not numerous, and we know little or nothing of the psychology of ferocity even among animals like the tiger, which have, as wild beasts, a terrible reputation, or among others which are extraordinarily intelligent, such as the elephant. Nevertheless I believe that, as we have been able to observe this fact in one of the most feared of carnivora and also among the most intelligent and those nearest to man, we are justified in asserting that the idea of death and the possibility of inflicting it by artificial means in the animal world is at least very indistinct, scarcely dawning, uncertain, and that if any species has arrived at such an idea, it is in such cases a mere dim and blurred outline.

It is therefore probable that the idea of murder is a prerogative of the human race, or that the human race is the only one which has arrived at the conception with great clearness, and that this superiority in man is a characteristic which differentiates him from all the other species of animals. Probably it was in this direction that, at a very early period, in the first beginnings of human life, and in that variety from which *Homo sapiens* emerged by selection, the intellectual force of the human species was directed, and that the comprehension of the difference between the state of life and the state of death, with the perception of the fact that living creatures might be made through certain co-ordinate actions to pass from the first state to the second, was one of the first and grandest discoveries of the human race. It is easy indeed to understand of what great use this discovery was to man in his struggle with animals physically superior to himself, to find himself in possession of the grand secret of life and death. The work of selection accomplished by man among the enemies of his species thus became systematic; it became, notwithstanding the physical feebleness of man's constitution, infinitely more efficacious than the destruction effected by man's foes, who were so much stronger, in the ranks of the human race. Governed and regulated by the clear idea of killing, with deliberate artifice, the enemies of the human race, this selection not only became a terrible weapon and assured victory to man in the struggle for existence, but it impelled him to perfect indefinitely those means of slaughter to which he owed his victory.

This discovery has been of such capital importance that one might say that the idea of killing and being killed is the fundamental idea underlying the mental system of the most savage human races—those that are nearest akin to animals—such as the Australian aborigines, the Botocudos, and the American Indians. It is well known that the savage races suffer from a perfect delirium of persecution, as witness their continual slaughter through some subtle invention of other men. The Australians even have no idea of natural death—can not conceive of a man's dying from any other than a violent cause; they believe that every one who dies has been killed by some hidden agency of destruction, just as he may have laid one low with an arrow. Hence the well-known Australian custom that, on the death of a member of the tribe, a relative must seek out some member of another tribe and kill him to revenge the supposed murder. Superstitions and cruel practices of primitive life, such as we find among the Australians, have their origin in the abuse of generalization from the one primitive discovery that one man has power over the life of another man, and one of the first mental efforts of humanity has lain in connecting these two general extensions of an idea which is at bottom just, and in connecting it by experience and observation so as to determine its real limits and to prevent man from seeing homicidal forces in every unexplained phenomenon of Nature. This idea was also fraught with importance in regard to forms of social life—an importance so fundamental that a great part of the work of primitive society was nothing but the practical development of this idea. The first form of social progress which we find in the advance of human society is progress in the manufacture of instruments of destruction—spears, daggers, knives, arrows, bows—for among almost all primitive peoples it is in their weapons that we first notice a wide differentiation and variety of shape. There have been many races that had only one form of house, very few articles of clothing or ornament, a single kind of food, or nearly so—none with but one kind of destructive weapon, a single form of knife, spear, bow. The capacity for committing conscious murder upon other beings, of its own or another species, has marked so fundamentally the superiority of the human race over all other species of animals that in the suggestions of this idea there have developed through long time all the mental activities of the human race. This fundamental idea was perhaps the first discovery of man, and ranks with that of fire as among the fundamental discoveries of the history of mankind; and if human cruelty has been only too capable of assuming forms infinitely richer and more varied than the simple cruelty of animals, it is to this discovery that the fact is due.

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A DECADE IN FEDERAL RAILWAY REGULATION.

By H. T. NEWCOMB.

IT is ten years since public dissatisfaction with methods of railway administration found legislative expression in the passage of the Interstate Commerce Law, which was practically the first attempt made by Congress to exercise, in relation to railway transportation, its constitutional power to regulate commerce between the several States. Whatever minor causes may have contributed to this dissatisfaction, there can be no doubt that the only subject of disagreement between the railways and the general public which constituted an at all adequate cause was the charges exacted for the movement of passengers and property. While it must be conceded that much of the complaint was unjust to the railways and arose through the fact that, particularly in the more exclusively agrarian sections of the country, much industry was conducted at a loss that might have been shifted to railway corporations could low enough charges for the movement of agricultural products have been secured, it is yet true that numerous individuals and communities had suffered grievous injury through unjust discriminations in the charges for railway service.

Unjust discrimination in railway charges being the evil that Congress intended to eradicate by the Interstate Commerce Law, the extent in which that result has been accomplished during the ten years since its enactment must be the measure of its success. If it has not materially diminished the unjust rate-making practices formerly so prevalent it will be fruitless to plead that it has, through the annual reports of the commission appointed for its enforcement, provided several volumes of most valuable and practical discussions of railway problems; that through a clause which has no direct connection with its substance, and might as well have been an independent enactment, it has given desirable impetus to the application of safety appliances to cars and trains; or even that in spite of limitations voluntarily imposed by the commission it has secured the compilation, under the skillful direction of a most accomplished statistician, of a mass of statistical information regarding the business of railway transportation that is of great utility to the student and may become an important factor in securing wise and adequate legislation.

The means that Congress provided for the prevention of unjust discriminations in charges were threefold, viz.:

First, a summary process for hearing and adjudicating complaints and enforcing relief; second, publicity of railway methods and accounts; third, perpetual competition among railways.

Though the tentative character of the law was acknowledged by the most vehement of its partisans, there has been as yet no amendment in any way modifying these fundamental principles. Those that have been passed—adding the penalty of imprisonment to that of a mere fine for violation of its clauses; extending the provisions requiring filing and publicity to rate schedules, in which two or more carriers join; requiring public notice of reductions as well as of advances in charges; and relating to procedure—have been at the direct instance of the commission and were advocated in its reports.

The first remedy lingers a living death in the reports of the Interstate Commerce Commission, and it may yet be resuscitated by suitable legislation, but it was deprived of all practical force, except as a contributor to publicity, when, in the first action brought to secure a decree enforcing an order made by the commission, a Federal court, in a decision that has been followed uniformly ever since, claimed the right to go into the matter at issue between the defendant railway and the complainant before the commission *de novo*, to hear new testimony if offered, to allow the railway to adopt a new line of defense, and to consider the conclusions of the commission as to law and fact as merely *prima facie* evidence subject to rebuttal.

Publicity was provided for by authorizing the commission to inquire generally into the business of all carriers subject to its jurisdiction; to keep continually informed regarding their business methods, by requiring annual statistical reports; authorizing the commission to prescribe a uniform system of accounts; requiring the publication and filing of schedules of rates on all traffic subject to the provisions of the law; requiring railways to file copies of agreements with other common carriers; and giving the commission authority to issue subpœnas and subpœnas *duces tecum.* Competition was to be perpetuated by the prohibition of pooling agreements. This and the second remedy have been enforced with reasonable continuity.

Charges for railway service may unjustly discriminate in three ways:

1. When differences are based upon the individuals for whom services are performed.
2. When charges upon different commodities are adjusted for the purpose or so as in effect to foster the movement of one at the expense of the other in a degree not warranted by differences appertaining to the commodities themselves.
3. When charges to or from particular localities favor some to the disadvantage of others more than is justified by natural conditions.

Unjust discriminations between individuals are those most readily observed, and consequently most obnoxious to the general public, though it is doubtful whether their consequences approximate in gravity the serious and deplorable effects of those that fall in the second and third classes. They are effected by means of secret deviations from the published rate schedules, while those between producers of different commodities or between localities appear boldly on the face of tariffs and classifications. The secret rates, rebates, drawbacks, allowances, or other illegal devices resorted to in order to accomplish the first class of discriminations are punishable by fine or imprisonment. The only remedies for the other kinds are modification of the rate schedules or monetary recompense for the damage suffered. The number of discriminations between individuals has been materially reduced by the operation of the present law, but that they have by no means disappeared is evident from the following extract, which, as it is taken from a recent issue of a railway paper of high standing, may be regarded as *ex cathedra :*

"At present no railway man dares to assist the commission to information against another road, no company dares to be the active instrument in bringing complaint against another. It has its own record behind it. There would be retaliation, and there is no great company which can face having its record of the past years subjected to investigation."

These discriminations are very effective in competition for traffic and will continue an important factor in the railway situation as long as competition is a controlling element in rate-making. It is not even certain that they are not more harmful at present than when more common, and it may be that their baneful effects are accentuated now that, instead of being granted to nearly every applicant, concessions from established charges are accorded only to powerful traders who are able to control traffic sufficient in quantity to yield revenue of almost vital importance to the carrying companies. One of the ablest men ever appointed to be an Interstate Commerce Commissioner has publicly declared that—

"If we could unearth the secrets of these modern trusts, whose surprising exploits excite such wide apprehensions, we should find an explanation of their menacing growth in the systematic methods by which they have evaded the burden of transportation. The reduced charges which they have obtained, sometimes by favoritism and oftener by force, account in great measure for the colossal gains which they have accumulated."

And he adds:

"Indeed, I think it scarcely too much to say that no alliance of capital, no aggregation of productive forces, would prove of real or at least of permanent disadvantage if rigidly subjected to just and impartial charges for public transportation."

Unjust discriminations prejudicial to particular commodities have not been materially reduced in number by the operation of the Interstate Commerce Law. They appear, as has been said, in rate classifications and rate schedules, and the burden of proof is usually upon those who allege that they are unjust. The commission, in response to complaints brought before it, has found it necessary to prescribe the proper relations between rates for carrying the following pairs of commodities: Common soap and pearline, dried fruits and raisins, lumber and hub blocks, lumber and railway ties, wheat and flour, corn and its products, grain and grain products, celery and green vegetables, window shades and hollands, and petroleum and its products. These, however, involve but the smaller side of the question. It is not clear that rates as at present adjusted are relatively reasonable as between, for example, the products of agriculture and those of other industries, nor that they do not bear with undue relative severity either upon the grain producer of the trans-Mississippi region or the cotton planter of the Gulf States. These are matters with which the Interstate Commerce Law does not effectively deal, and which can not be so dealt with until the law is modified in a manner more radical than any yet officially suggested.

The most serious class of unjust discriminations includes those which have for their victims the entire populations of towns, cities, and even extensive districts which are made to suffer from the unfair adjustment of railway rates. Practically the whole region south of the Potomac and Ohio and east of the Mississippi has continuously suffered from discriminations of this kind through the system of making charges to a few selected cities the basis for through rates to all other points. Through rates are made to and from about two hundred of the larger towns, including Atlanta, Birmingham, Chattanooga, Vicksburg, New Orleans, and Mobile, and traffic shipped from or to all other points is charged the rate to one of these basing points plus the local rate from such basing point to final destination. In practice it is common to make the combination by the use of rates to and beyond whatever basing point will give the lowest total, whether on the line traversed by the shipment or not. Thus a shipment from Cincinnati to a point on the line from that city to New Orleans may be charged the full rate to New Orleans plus that from the latter back to the local point. The condemnation of such a system can not be too severe. It not only limits the commercial activities of the towns unjustly discriminated against and restricts the sources from which they can directly draw supplies, but by hindering their growth it retards the development of the entire section, including the cities supposed to be favored.

The manner in which competition at points served by two or more railways affects those having but one has received general recognition, and is one of the most powerful causes of the too rapid construction that has burdened the country with many unnecessary, unprofitable, and bankrupt lines. To attempt to regulate these cases by the process of taking them up singly and prescribing the alterations necessary to make the charges relatively reasonable, is a task impossible on account of magnitude. Though the relief afforded to particular places through the orders of the Interstate Commerce Commission has often been of great local importance, a large number of its decrees, including those most important, have been entirely ignored, or are now awaiting enforcement through the tedious processes of the courts. Even had the commission itself the authority of a United States court, and were there no appeal from its decisions, the town with two railways would still have an immense advantage over that with one.

In the case of the Eau Claire Board of Trade, decided by the Commission in 1892, it was contended that the rates charged on lumber from Eau Claire to points on the Missouri River were so high relatively to those from points competing for the business of supplying the same markets, as practically to destroy the business of Eau Claire. Only a few of the roads serving these competing points reached Eau Claire, and accordingly the only practical mode of adjustment, from the standpoint of the law, was to order a reduction from that point. This the commission did, but added:

"Undoubtedly those roads" (referring to those not serving Eau Claire, and consequently not included in the order) "have it in their power to continue the present disparity, but we do not anticipate, and certainly can not assume, that they will resort to such inconsiderate and arbitrary action in order to nullify the lawful order of this commission."

The compliance of the defendant railway with the order of the commission was, however, almost immediately nullified by the action upon the part of the other railways which that body had most properly refused to anticipate, and the rates of all lines were ultimately restored to practically the figures in effect previous to the complaint.

The conditions described are fairly typical of those existing all over the United States. The Interstate Commerce Law has mitigated but slightly, if at all, the evil of unjust discrimination between individuals, has in but few and relatively insignificant instances moderated unjust discriminations between articles or classes of traffic, and has almost wholly failed to remedy the far more serious inequities in rate-making which operate to the disadvantage of towns, cities, or districts.

If it were true that the single step necessary to prevent or alleviate considerably the evils described is to re-enforce the law by adopting the amendments suggested by the commission, or otherwise to perfect the remedies already provided, adequate and early relief might reasonably be hoped for. That the commission does not take this complacent and superficial view is evident from the following extract from its Ninth Annual Report:

"Those who have given most reflection to the subject of government regulation are aware that the laws now in force are more or less tentative and experimental, and such persons anticipate that the evolution of railway control by public agencies will sooner or later result in a more comprehensive and direct exercise of the power possessed by Congress to regulate our internal commerce."

In fact, while the commission is, to adopt its own phrase, asking Congress merely "to make the act mean what it was supposed to mean at the time of its passage," it must be itself aware that it then contained the cause of endless discriminations. Says Commissioner Knapp:

"The power to compete is the power to discriminate, and it is simply out of the question to have at once the absence of discrimination and the presence of competition."

And he adds:

"I regard the existing law as presenting this singular anomaly, that it seeks to enforce competition by the mandate of the statute, and at the same time to punish as criminal misdemeanors the acts and inducements by which competition is originally effected."

The unreasonable rate not made either to secure competitive traffic or to recoup losses from carrying such traffic at too low rates is so extremely rare that its very existence may well be doubted. Unjust discriminations between individuals are resorted to in order to secure by means of secret rates, rebates, or other devices a greater proportion of the traffic from or to competitive points than would be carried at open and equal rates. Discriminations between commodities result most frequently from favoring articles produced by heavy shippers or in towns at which competition is sharp, or from the fact that the railways agreeing to a particular classification have not a sufficient identity of interest to make naturally for harmony and justice. Localities either are favored unduly because they are served by competing lines, or are discriminated against in order that low rates may be maintained at other points more fortunate in this respect. The charges to local points on main and branch lines are too high relatively to those at terminals where there is competition. Yet it can not be denied that so long as the carriers are independent of each other in the matter of revenue there will be many plausible arguments available for the defense of these relations. The difficulty of dealing with such discriminations is greatly enhanced by the insufficient information upon which it is necessary to decide regarding the reasonableness of rates under present conditions. Thus, in determining whether a given rate on wheat from Chicago to New York is reasonable and just, it may be necessary to consider the rates on the same articles to Buffalo, New York, Philadelphia, Baltimore, Boston, Montreal, Newport News, and other Eastern points not only from Chicago, but also from Minneapolis, Duluth, East St. Louis, Peoria, Cincinnati, Buffalo, and other places. Rates on flour, corn, and corn meal between any of those points may also be involved; and possibly the charges on any of the commodities named from St. Paul or St. Louis to New Orleans *via* the Mississippi River boats, and from New Orleans to New York or Liverpool by steamer, may in some way be connected with the controversy so as materially to affect its decision. In fact, it is impossible to set any limit to the data that may have important bearing upon the question at issue, or to say of any fact concerning commerce or transportation that it would necessarily be wholly irrelevant in such a controversy. Yet the parties defendant, when such a case is heard before the Interstate Commerce Commission or the courts of the United States, are the carriers between Chicago and New York only. When the interdependence of all rates is thoroughly understood and the extent and importance of this condition fully appreciated, it will be a matter of little surprise that through the absence of sufficiently comprehensive information in particular cases, and through the impracticability of treating the subject of railway rates under the present system in the broad and thorough manner absolutely essential to the correction of the evils now existing, even the clear-headed and able men who have constituted the Interstate Commerce Commission have been led into occasional errors which have furnished arguments to those who from self-interest desire a return to the system in vogue when there was no public supervision of interstate commerce by rail.

The conflict of interest between the several corporate units of the railway system is the primary cause of the evils attendant upon railway transportation as now conducted. This fact being clearly established, it is at once evident that that portion of the Interstate Commerce law which was intended to perpetuate competition—i. e., the fifth or antipooling section—is radically antagonistic to any wise and practicable system of railway regulation. It is necessary at the outset, as a first step toward a system under which railway rates can be made equal to all, that this restraint upon the carriers should be removed—not in order to save them from the bankruptcy that is almost certain to follow the vicious methods now in vogue; not for the sake of the thousands whose small savings have been invested in railway securities in the reasonable belief that Congress would not legislate so as to destroy an investment through which private capital is made to perform a public function, but in order to relieve individuals, classes of property, and localities from the unjustly discriminating charges for railway service from which they now suffer. At the same time Congress should give some substantial finality to the findings of the board of railway experts which under the name of the Interstate Commerce Commission it has created to adjudicate between the railways and their patrons, and should strengthen the visitorial functions of that body by granting whatever amendments to the law are necessary in order to secure the production of all the legal testimony desired and by considerably widening the scope of its statistical investigations.

But this is only a beginning of progress toward more enlightened methods of dealing with this important industry. It has never been found profitable to legislate in restraint of natural economic forces, but the best results have accrued when statesmen have frankly recognized the tendency of those forces and have sought to make their operation useful to society. The force which tends toward the consolidation of railway properties is one of the most powerful, and it is now recognized that such consolidation is in the public interest. All provisions forbidding or hindering the various forms of consolidation of parallel or connecting railways, whether contained in State Constitutions or in Federal or State statutes, should be repealed, and public and legislative encouragement so far as practicable should be generously accorded to every step that tends toward the complete harmonization of the railway system. If this somewhat radical change in the attitude toward the railway monopoly can be effected it will not be long before favoritism will become as rare in railway rates as in the rates of taxation.

EARLY AMERICAN CHEMICAL SOCIETIES.*

BY PROF. H. CARRINGTON BOLTON, PH. D.

THREE chemical societies were organized in the United States before the close of the first quarter of this century: 1. The Chemical Society of Philadelphia, founded in 1792. 2. The Columbian Chemical Society of Philadelphia, founded in 1811. 3. The Delaware Chemical and Geological Society, founded in 1821. These societies were short-lived, local in jurisdiction, and without much influence on the progress of the science; but it is interesting to note that professional, teaching, and amateur chemists in America formed associations for mutual improvement and for the advancement of their calling forty-nine years earlier than their brethren in England. American chemists were not impelled to form independent societies owing to a lack of organizations for men of science, but they early felt the advantages of specialization. Both the society of 1792 and that of 1811 were formed in a city honored by the presence of the venerable and dignified American Philosophical Society, established by Benjamin Franklin in 1743.

1. The Chemical Society of Philadelphia was undoubtedly the earliest organized body of chemists in either hemisphere; it does not appear to have published records of its meetings, but in 1801–'2 it was presided over by Dr. James Woodhouse, the vice-presidents being Felix Pascalis and John Redman. Dr. Wood-

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* Abstract of a paper read to the Washington Chemical Society, April 8, 1897.

house (1770–1809) was at the time Professor of Chemistry in the medical department of the University of Pennsylvania, of which he was a graduate. This chair had been held by Dr. James Hutchinson, and on his death, in 1793, Dr. Joseph Priestley, who arrived from England a few months later, was invited to succeed him, but he declined, preferring retirement at Northumberland, and Dr. Woodhouse was chosen instead. He was more of a physician than a chemist, and most of his writings were on medical topics, but he edited Chaptal's Elements of Chemistry and other works. He is said to have been the first to prove by comparative experiments the superiority of anthracite coal from Pennsylvania over bituminous coal from Virginia for intensity and regularity of heating power.

The first vice-president, Felix Pascalis-Ouvrière (1750–1840), had an interesting career. He was born in France, where he received his medical education, but emigrated to Santo Domingo, and while practicing his profession there acquired an extensive knowledge of botany and other branches of natural history. In 1793 a revolt among the negroes compelled Pascalis to take refuge in the United States: he settled first in Philadelphia and afterward in New York, where he aided in founding the Linnæan Society of New York. The second vice-president, Dr. John Redman (1722–1808), was one of the foremost practitioners of medicine in Philadelphia, and from 1786 was President of the Philadelphia College of Physicians.

Among the most active members of the Philadelphia Chemical Society were Priestley, Hare, and Seybert. The ambition of the members is shown by the circumstance that a standing committee in 1802 was prepared to "annalize every mineral production" sent to them, free of expense. The meeting held October 24, 1801, was made memorable by the appointment of a committee for the "discovery of means by which a greater concentration of heat might be obtained for chemical purposes." One of the committee, Robert Hare, then only twenty years of age, reported to the society on December 10th his invention of the "hydrostatic blowpipe." Hare's remarkable paper was printed in a small pamphlet of thirty-four pages with the title, Memoir on the Supply and Application of the Blowpipe, containing an account of a new method of supplying the blowpipe either with common air or oxygen gas. Hare's invention yielded a fruitful harvest of discoveries and alone justified the existence of the first of chemical societies; his subsequent career as Professor of Chemistry in the medical school of the University of Pennsylvania from 1818 to 1847 is well known.

2. The Columbian Chemical Society of Philadelphia was founded in the month of August, 1811, by a "number of persons

desirous of cultivating chemical science and promoting the state of philosophical inquiry."

The principal officers elected at the first meeting were as follows: Patron, Hon. Thomas Jefferson, Esq.; president, Prof. James Cutbush; vice-presidents, George F. Lehman, Franklin Bache.

Thomas Jefferson's commanding position in the world of science and arts, as well as his literary attainments, well qualified him for the office of patron; he was at that time living at his country seat in Virginia, having already served his country for eight years as chief magistrate.

The president of the society, Dr. James Cutbush, was Professor of Natural Philosophy, Chemistry, and Mineralogy at St. John's College; in 1814 he held the position of assistant apothecary general in the army, and he afterward became Professor of Chemistry and Mineralogy at the United States Military Academy, West Point, where he died in 1823. Dr. Cutbush published several books, the best known being A System of Pyrotechny (Philadelphia, 1825), an elaborate work of six hundred pages.

Franklin Bache, the second vice-president, was at that date a youth of only twenty years, who had graduated the year before at the University of Pennsylvania. He was a grandson of Benjamin Franklin and a member of the distinguished Bache family which numbered so many eminent men of science. He afterward became Professor of Chemistry at the Jefferson Medical College, a position which he held until his death in 1864.

The constitution adopted by the founders of the society, besides the usual business rules, contained some unusual features. The officers included an orator, whose duty it was to deliver an oration on some chemical subject once every year. Since the Society's Memoirs contain no "oration," it is to be feared that the incumbent's efforts were not satisfactory. The constitution undertook to control the members' actions by a series of fines: twelve and a half cents for absence each roll, and one dollar for refusing to accept an office or declining to read an original chemical essay when appointed to do so. To insure against members withdrawing early from a dull meeting, the secretary was directed to call the roll at the opening and close of each meeting, and to fine absentees twelve and a half cents. Candidates for membership were required to read an original essay on some chemical subject to be discussed by the members, and a two-thirds vote was required to insure election. It seems to have been easier to be put out of the society than to get into it, for "any member behaving in a disorderly manner shall be expelled by consent of two thirds of the members present."

There were two classes of members: "junior," thirteen in number, and "honorary," sixty-nine in number, of which thirty-one were Europeans; the home list included most of those chemists whose labors contributed largely to the foundations of the science in the New World. Brief notices of the prominent ones are here given:

Dr. Benjamin Smith Barton (1766–1815), who has been called by his admirers "the father of American natural history," held the chair of medicine, natural history, and botany in the University of Pennsylvania; he was an agreeable writer on natural history topics.

Dr. Archibald Bruce (1777–1818) was one of the pioneers of mineralogical science in America, and published one volume of the American Mineralogical Journal in 1810; he held the chair of mineralogy in Columbia College, New York.

Thomas Cooper (1759–1840), born in London, accompanied his friend Priestley to America in 1793, sharing his radical views in politics and religion. He held the chair of chemistry at the college in Columbia, S. C., of which he afterward became president.

Dr. Edward Cutbush (1772–1843) was surgeon in the United States Navy and Professor of Chemistry in the medical school of the Columbian University from 1825–'27.

Dr. John Griscom and Dr. David Hosack were both citizens of New York; the former had the honor of being regarded as the head of all teachers of chemistry in New York for thirty years; the latter was Professor of Botany and Materia Medica in Columbia College, but is best known as the founder of the first public botanic garden in the United States in 1801. He died under tragic circumstances—of shock at the disastrous conflagration in New York city which swept away his property to the value of $300,000.

Dr. John Maclean (1771–1840) was the first Professor of Chemistry in the College of New Jersey, now Princeton University, to which chair he was elected in 1797.

The Hon. Samuel L. Mitchill, M. D., F. R. S. E. (1764–1831), was not only an active Professor of Chemistry and Natural History in Columbia College, New York, and editor of the New York Medical Repository, but he was Senator of the United States from 1804.

Dr. Benjamin Rush (1745–1813) was undoubtedly the first professor of chemistry in America, his appointment dating August 1, 1769. In his busy life he was Professor of the Institutes and Practice of Medicine in the University of Pennsylvania, besides acting as Surgeon General of the United States Army, Treasurer of the Mint, President of the Society for the Abolition of Slavery, and Vice-President of the Bible Society of Philadelphia, in which city he also conducted a large medical practice.

Dr. Adam Seybert (died 1825) was a pioneer in air analysis, having made twenty-seven analyses of the air by eudiometric methods on a voyage across the Atlantic in 1797. He came to the conclusion that the sea exerted purifying power over the air.

Benjamin Silliman, at the time of the founding of the Columbian Chemical Society, was forty years of age and had held the chair of chemistry in Yale College for ten years. The American Journal of Science was not begun until 1818. Silliman's name is a household word among us, and no eulogium is here needed to magnify his position in the scientific world.

The prominence of medical men on the roll of members is evident and readily explained. Before the days of schools of science, and before colleges devoted a portion of their curricula to scientific studies, almost the only training in science received by American youth was in the medical schools. The chairs of natural history and of the physical sciences were almost exclusively held by physicians whose education more nearly qualified them for teaching these branches of knowledge than the graduates of the classical courses customary in all colleges. To elevate the standard of membership in the Columbian Chemical Society a number of distinguished foreigners were enrolled. These included such men as Berthollet, Gay-Lussac, John Dalton, Sir Humphry Davy, and Dr. Wollaston, but no representatives of Germany or Sweden, which presumably indicates that at this early date communication and exchange of courtesies with Germany and northern Europe were less common than with France and England.

The society issued in 1813 one volume of Memoirs, containing twenty-six essays by ten writers on a great variety of topics—original, speculative, and practical. Eight of these papers are from the pen of Dr. Thomas D. Mitchell. In his Remarks on the Phlogistic and Antiphlogistic Systems of Chemistry he supports the Lavoisierian theory of combustion, stating that there is "no necessity for a principle of inflammability." He cites the experiment of Woodhouse, who obtained an inflammable air by heating charcoal with scales of iron, both being free from water; and points out that Cruikshank, of Woolwich, demonstrated that the inflammable gas thus obtained is gaseous oxide of carbon (carbon monoxide), discovered by Priestley in 1799 and combustible although containing no hydrogen. He compares combustion with neutralization of an acid and base, and says, "Inflammation and acidity are effects resulting from the action of relative causes and not attributable to a single agent or principle."

Dr. Mitchell, in his paper Remarks on Heat, objects to the term "latent heat" and to Dr. Black's theories. In a paper entitled On Muriatic and Oxymuriatic Acids he attacks the views of

Sir Humphry Davy as to the non-existence of oxygen in muriatic acid, clinging to the statement of Lavoisier that all acids contain oxygen, and he claims that combustion is accompanied by decomposition of oxygen gas. The doctor's Analysis of Malachite from Perkioming, Pa., is given as follows: One hundred and twenty grains of the green carbonate contained carbonic acid, thirty grains; quartz and siliceous earth, sixty-eight grains; brown oxide of copper, fifteen grains; loss, seven grains. The specimen was evidently a poor one. No account was taken of the water, and reporting results in percentages does not seem to have been in vogue.

The same writer, in Remarks on Putrefaction, discusses the action of antiseptics and attributes the virtues of nitrate of potash to the increase of cold produced by the muriate of soda. His other papers are argumentative and speculative, with little originality.

Franklin Bache's three papers are likewise speculative disquisitions. In one he points to the "great error" in which Berthollet fell as respects the law of chemical affinity, and in another he proposes to introduce the following improvements in nomenclature: Nitral acid forming nitrotes; nitril acid forming nitrutes; nitrous acid forming nitrites; and nitric acid forming nitrates.

Four of the papers in the Memoirs are by Dr. John Manners. His Experiments and Observations on the Effect of Light on Vegetables abounds in quotations from Darwin's Botanic Garden. In the Mineral Spring at Willow Grove, fourteen miles from Philadelphia, he found iron and sulphureted hydrogen. In Experiments and Observations on Putrefaction he tested the influence of carbonic acid, hydrogen, and other gases on putrefying flesh, and he attempted to collect and analyze the gases generated by the same. He concludes that "putrefaction depends on a destruction of the equilibrium of attractions which exists in the elementary principles of which the animal substance is composed in a healthy state, occasioned by the loss of vitality in consequence of which new compositions and decompositions ensue."

The president of the society, Prof. Cutbush, describes quite clearly the "oxyacetite of iron" as a test for the detection of arsenic, a process since used quantitatively by Kotschoubcy.

Speculations on Lime, by Dr. Joel B. Sutherland, contains the singular claim that if mortar be made with sand containing common salt the resultant compound gives "so much coldness to the mass that during the whole summer vapor is almost incessantly precipitated on a wall" with which it is plastered.

Mr. Edward Brux, of France, one of the junior members, writes Upon the Effects of Various Gases upon the Living Animal Body, which consists largely of speculations, notwithstanding which he cites an admirable passage from Dr. Bostock: "Physiologists have in general been more inclined to form hypotheses than to execute experiments, and it has necessarily ensued from this unfortunate propensity that their science has advanced more slowly than perhaps any other department of natural philosophy." Unfortunately, this truth was not fully recognized by the members of the Columbian Chemical Society.

A contemporary journal (New York Medical Repository) reviews the Memoirs in the following quaint style: "It is highly gratifying to behold a band of worthies like those before us laboring to analyze the compounds which they find ready made, to form by synthesis new combinations in the laboratory, and thereby to deduce correct doctrines from the facts which are disclosed. We cordially congratulate them on their noble occupation and on the progress they have made. We hope they will be persevering and undaunted; and if from this beginning there shall arise great improvements in theoretical disquisition, as well as in economical exercise, we shall rejoice with a mingled glow of amicable and patriotic sentiment."

3. The Delaware Chemical and Geological Society was organized at Delhi, Delaware County, New York State, September 6, 1821. The first meeting was held at the hotel of G. H. Edgerton, in the village. The president was Charles A. Foote, and the vice-president the Rev. James P. F. Clark. The society was composed of "between forty and fifty well-informed and respectable inhabitants of the county." It had for its object the improvement of the members in literature and science, especially in mineralogy and chemistry. The members planned to form a library, and they made a collection of the minerals and rocks of the region, but the society was not long sustained.

In reviewing the condition of chemical science in the United States as indicated by the membership and achievements of these early societies, we note that those who held the most prominent places were handicapped by the necessity of devoting a large part of their intellectual energy to topics quite outside of the domain of chemistry itself. The active members were either busy with the art of healing or with teaching several branches of the physical and natural sciences, and too often chemistry was regarded in the colleges as a kind of side issue or appendix to the more important subjects of instruction. This was caused by the necessity of earning a competence at a time when there was no opportunity of reaping pecuniary rewards by skill as an analyst or by the application of science to the manufacture of products involving chemical knowledge. Indeed, in default of this stimulus to laboratory work it is not surprising that the papers read to the societies were largely either reviews of the grand discoveries made by

Europeans or essays in which the imaginative faculty was given free play, it being far easier to indulge in speculations than to discover new facts.

In the early struggles of a country to secure a place among nations few men of ability can devote their energies to the pursuit of science for science's sake. The environment is more favorable to development of the inventive faculty than of the peculiar talent for conducting abstruse researches in an exact science. Add to this the limited facilities for acquiring chemical knowledge in the New World and the distance of amateurs from the European head centers of learning, and it is certainly noteworthy that American chemists combined to form associations for mutual improvement and the advancement of their calling at so early a period.

A fourth attempt to establish a chemical society was made at New York city in 1876. The organization was at first somewhat restricted in its plan, but in 1892 a change in its constitution was effected which broadened its scope, and it now forms a strong, influential, and truly national society. Its nine hundred and eighty-four members, working in nine chartered sections, represent forty-seven States and Territories, besides several countries of Europe, South America, and distant Australia. Its Journal, comprising eleven hundred and fifty pages annually, is an authoritative medium for the preservation and diffusion of the researches made in the United States, and its annual meetings, held in diverse localities, strengthen the bonds which unite its members in good-fellowship and in the pursuit of their common profession.

THE recent publication of Mr. H. W. Seager's book, Natural History in Shakespeare's Time, has incidentally made it evident that our master poet was great in this as in all other fields, and that his allusions to animal life and habits are not based on the fables in which his contemporaries indulged even when writing seriously on the things of Nature, but on his own or other accurate observations. Of such are his allusions to the quick breathing of the captured sparrow, to the fast work underground of the mole, to the wounded duck hiding among the sedges, to the scattering of the wild geese at the firing of the fowler's gun, and his lamentation over the killing of a fly by Marcus. An English reviewer of the book well says that "the truth is that Shakespeare's natural history is modern in its vividness, its good sense, its sympathy. It is more profitable to compare his bird lore with Gilbert White's than with anything in Bartholomew; more just to set his animals against Buffon's than the grotesque 'four-footed beasts' of Topsell; more useful to verify his botany by Sowerby than by Gerarde or John Parkinson. Modern naturalists and Nature-lovers have not been slow to claim Shakespeare as their brother." Yet his characters sometimes bring in the natural-history fables of the time. They would not be true to what he intended to make them appear if they knew better.

THE ECONOMIC VALUE OF ANIMALS.

By CHARLES FREDERICK HOLDER.

THE influence which the lower animals have had upon mankind has never been appreciated; had it been, they would have received more consideration at our hands. They not only provide us with food, raiment, and a vast array of industries, but they have been factors in the physical and intellectual development of mankind. The beauty of the birds and insects, the splendid coloring of the fishes and reptiles, the quiet harmonies of Nature and the problems they suggest, have insensibly had a refining effect, and aided in the evolution of the higher and æsthetic senses. In a word, the so-called lower animals have been important factors in producing the high civilization which marks the Caucasian race of to-day.

In glancing at the many forms which pay tribute to our wants and requirements, the larger animals naturally attract the attention; yet the greatest works, the most enduring monuments, are those produced by the smallest and most insignificant creatures. Such are the rhizopods—minute marine forms almost invisible, among the very lowest in the scale of life; literal drops of jelly, yet endowed by Nature with the power to secrete shells of rare and beautiful shapes. So vast are their numbers that it has been estimated that if they are as numerous down to a depth of six hundred feet as they are near the surface, there are more than sixteen tons of calcareous shells suspended in the uppermost one hundred fathoms of every square mile of the ocean.

These countless millions are constantly dying, and their shells when released slowly sink to the bottom in a never-ending rain, filling up the inequalities of the ocean bed, and forming a deposit of ooze at a depth of not over twenty-four hundred fathoms several feet in thickness, beneath which are layers of shells of an unknown depth pressed into a solid mass. A prolific source of this ocean rain is a rich spiked atom which has given its name to the globigerina ooze that is almost universal in the deep sea at a depth within the limitations given.

The tendency of the rain of shells is to fill up ocean beds, cap submarine hills and mountains, building them up until they enter the zone of the reef-building corals. In this way these insignificant creatures have aided in the growth of the globe, and, when the deposits by heat or exposure to air are hardened, they become girders of the crust.

The ooze so deposited either fills up the ocean, or by some upheaval is lifted into the air and in time becomes covered with a forest growth; ages pass, and, by a depression of the crust, the hardened ooze again becomes the bottom of an ocean, subject to another rain of shells; and so the change goes on, and we may trace the rhizopods back to the Archæan time, millions of years ago, their story being told by the limestone deposits alternating between the metamorphic schists of that ancient period—monuments of the part these insignificant creatures have taken in preparing the world for man. The chalk cliffs of England are among the visible evidences of this work, the chalk being formed of rhizopods once deposited at the bottom of a sea, but now reared high above the surface to tell the marvelous story. The city of Paris is built of stone formed by rhizopods and other forms, and the pyramids of Egypt are constructed of the remains of various species of fossil animals; yet how these magnificent works of man pale into insignificance before the unconscious work of these minute animals!

Very near the rhizopods are the sponges; lowly creatures whose skeletons are of great value—their collection and preparation forming a vast industry in many parts of the world; a step higher in life we find the coral polyp, secreting lime and piling up reefs and islands that are important girders of the globe. I have spent days in following a coral reef in the Helderberg Mountains of New York far from the reefs of to-day; and we find evidences of them everywhere in the rocks of early geological times. The great reef of Australia, the populous coral keys of the equatorial Pacific, the State of Florida, a reef of seventy-eight thousand square miles in extent, illustrate the value of this polyp to man.

All these animals have other values. From the rhizopod cliffs of Dover comes chalk, while heat is supposed to have changed the skeletons of sponges into flint, so valuable in many ways. Heat has transposed the old coral reefs into beds of marble; and we have the Capitol at Washington, and all the noble works of art of the old Roman and Grecian masters, carved from the crystallized remains of these lowly creatures.

The shells of the seashore and river all have a direct value; the oyster industry of New York city alone represents a capital invested of over two million dollars, which means the support of thousands of men, women, and children. Even the discarded shells constitute an important branch of trade in themselves. Germany and England use tons of pearl oysters, sending them to us in the form of buttons, cheap ornaments, and other articles. The pearl fisheries of the Persian Gulf pay one million dollars per annum; of Australia, three hundred and eighty thousand dollars; while those of Lower California have produced some of the finest and most valuable pearls during the past two centuries. The collection of abalone shells in the State of California means an income of over fifty thousand dollars to the parties interested, while the sale of the polished shells as curiosities gives employment to many persons. From the whelks a dye is obtained; sepia comes from the cuttlefish or squid; while one species provides the cuttlefish bone of commerce. The smallest worm, which Shakespeare tells us, "will turn, being trodden on," has its place in the economy of life. The phosphorescent worms add to the splendors of the festivals of the nights along our shores, and are among the illuminators of the ocean; as bait they have a relation to the fisheries; leeches have a medicinal value, while the common earthworm is a valuable ally of the farmer. Darwin estimates that there are one hundred thousand earthworms in the upper six feet of every acre of ground in favorable localities, and in New Zealand three hundred thousand. They are continually turning over the soil, dragging down seeds and leaves, and bringing to the surface in some places ten tons of mold to the acre every year, thus performing a valuable service to the agriculturist.

The crustaceans are among the important scavengers of the sea and are also valuable as food for fishes. The collection of crabs, shrimps, and lobsters forms large industries all over the world, contributing directly to the support of man. In Delaware the horseshoe crab is used as guano, while the collection of fossil crabs, as trilobites, is a peculiar industry. The fresh-water crayfish produces a concretion used as an antacid, well known to chemists. We owe many of the beauties of our summer fields to insects, all of which have their special functions and use. Even the persecuted flea may render man a service by keeping the drowsy watch dog awake, while the mosquito in tropical countries may aid in preventing the human inhabitants from living a continual *siesta*.

The flies are among the most valuable insect scavengers. The spiders prey upon flies, holding them in check. The silk of the spider is used as a cross line in astronomical instruments, and that of a Bermuda species as sewing silk. Bridge makers have obtained valuable suggestions from these silent workers, from whose web one of the kings of France is said to have made a coat. Grasshoppers and locusts are enemies of civilized man, but are eaten by the Indians, while in the Malay country the dragon fly is considered a delicacy.

The cochineal produces the famous commercial dye, a valuable industry. Manna comes from the puncture of an allied insect, while another insect produces wax. A popular eye powder among the Chinese is made from a fly. The silk industry in the United States, the product of the silkworm, represents a capital of twenty-seven million dollars, and the moths and butterflies perform an equally valuable work in fertilizing flowers, thus insuring the crops. A decoction of oak and other galls of the gall fly is an important ingredient in certain inks. Ants are valuable scavengers, and some produce an acid used in trade. The remarkable honey ants of the Southwest are considered dainties in Mexico and served after dinner alive. In the nests of these ants certain individuals cling to the ceiling, their abdomens filled with honey, which has been given to them by their companions, so they are literally living honey jars, holding the reserve food supply of the others, which they give up on application. The distended abdomen, about as large as a currant, is the luxury of the Mexicans.

Bees have a sterling value the world over and support many men, women, and children. A few years ago a single bee ranch in San Diego County, California, produced one hundred and fifty thousand pounds of honey and wax. The importance of bees, aside from the question of honey, is shown by the fact that it was found impossible to cultivate red clover in New Zealand, as there were no bumblebees to carry the pollen. These are but a few of the benefits we obtain from the insects, the majority of which are generally considered pests.

The story of the economic value of vertebrate life would mean a part of the commercial history of the world, so essential are nearly all of the higher animals to man and his advancement. We may pass rapidly in review the great fisheries of the globe which afford a direct support to thousands, from the salmon canneries of Alaska to the tunny fishermen of the Mediterranean.

The sharks, valuable scavengers, provide the makers of swords, belts, and various fancy articles with leather, the teeth being made into fancy and cheap jewelry. On the New England coast the small sharks or dogfish are in demand as guano, the fisheries giving employment to hundreds of men during the summer months. The oil of nearly all sharks is a commercial commodity, while the shark fin is a delicacy to the Chinese and collected by the ton from Catalina to China.

The torpedo ray has been utilized by science, and the electric catfish of Africa is sometimes employed as a medicine.

The Volga sturgeon fisheries give employment alone to over one hundred thousand persons, while that of our Alaskan coast is an important and growing industry. Helmets are made from the porcupine fish. The oil of the sunfish is valued in medicine. Shagreen comes from various fishes; leather and isinglass from the cod, hake, and haddock, weak and drum fishes; while the scales of the tarpon and parrot fishes are employed in ornamentation. Carp, dace, tench, and other fishes generally considered of little value, produce scales from which artificial pearls are made, and so become factors in a large and growing industry, especially in France.

The importance of fishes as food need not be mentioned. In the mere enumeration of useful products of animals but a faint idea can be gained of the vast interests they present. The National Museum, under the direction of the late lamented Prof. Goode, arranged a collection which illustrates the value of fish and fishing in all the details from the jewfish, that is made into boneless cod, to the feather fly, whose manufacture gives employment to hundreds of women and girls in New York.

The products of fish give rise to numerous industries, among which may be mentioned isinglass from the sturgeon; caviare; leather from eelskins, and guano from catfish. Then come the trades associated with the capture of fishes—the dealers in fishing tackle, the builders of fishing boats, the makers of fishhooks, sinkers, and artificial bait being a few that will suggest how the fishes indirectly enter into the life of man and aid in his support.

Passing to the reptiles and their allies, we find the frogs and lizards destroying noxious insects, ridding the gardens and trees of pests. The skin of large snakes is made into leather; that of smaller varieties into belts, hatbands, covering for boxes, etc.; while snake oil is highly valued for various purposes. In South America the white meat of the great boa is esteemed a delicacy. A political economist, whose name I do not recall, has stated that wars are a necessity to kill off the surplus population. This philosopher would probably consider the snakes of India in the light of a benefit, as since 1870 they have destroyed over two hundred thousand natives.

We obtain our real tortoise shell from the hawksbill turtle, the beautiful substance being made into countless articles, forming important industries in themselves. The Florida crocodile and alligator are on the verge of extinction that we may have satchels and the hundred and one objects in this leather which the ingenious makers give us. Every portion of the animal is of value. The teeth are made into jewelry, the oil soothes the rheumatic patient, while alligator musk forms an ingredient in the manufacture of perfumes.

The direct benefits which we obtain from the birds are well known. The egg, poultry, and wild game industry, the sale of pet birds, the extravagant use of plumes and feathers at the dictates of fashion, the sale of birds and eggs for specimens, the manufacture of fly-fishing bait, are but a few industries which afford employment to thousands all over the world and represent the investment of vast sums of money. Some of the peculiar products of birds are leather from the feet of tropic species, the albatross; pipestems from the leg of the latter; quill pens, penguin-feather furs, and penguin skins as fuel at Heard Island; the oil of gulls as lamp oil by Eskimos; leather from the pouch of the man-of-war bird; and tobacco pouches from that of the pelican. In heathen China the beautiful little quail is used by noble ladies to warm the hands in winter, and in civilized America live pigeons are used as a target by our so-called sportsmen. Many birds are becoming extinct, due to the demand for them by exacting fashion. Every hummingbird, bluebird, heron, or curlew in California and Florida has a price upon its head.

A value which birds have to man should not be omitted, namely, their work in distributing seeds, thus aiding in rendering islands habitable for mankind. This can be illustrated by the work of pigeons at the Moluccas. The Dutch destroyed all the nutmeg trees except those on the island of Great Banda, but were obliged to send a yearly commission to cut down the trees which grew from seeds transported to the island in the crops of the fruit pigeons. Coffee and other seeds are transported in the same way.

Among the higher or milk-giving animals there is hardly one that is not of some distinct value to man. The fur-bearers are well known, from the fast-disappearing fur seal to the common cat, over a million skins of which are used every year in the trade and sold as Alaska sable; six million squirrel skins are used by furriers every year, while thousands of common ratskins are employed in the manufacture of kid-glove thumbs. Muskrats contribute three million skins annually to the trade, and musk as well. The skunk, kangaroo, and other little suspected animals are all important factors in trade. Among the singular leather producers are the raccoon, peccary, cat, dog, for drumheads; white whale, which is dressed as kid, velvet, or plush; porpoise, and hippopotamus.

Every portion of almost every animal is available for the requirements of man: parchment from the viscera of seals and bears, gold-beater's skin from those of the ox, and catgut from those of the sheep. The hair of many animals is used in an infinite number of ways, from that of the skunk in fine brushes to that of the badger, dog, camel, hog, and others for coarse kinds. From the hoofs, bones, and horns of animals comes gelatin, used in the manufacture of court-plaster, jelly, and artificial flowers.

The oils of the milk-givers represent a vast interest. Some of the most singular are porpoise-jaw oil, used in lubricating fine watch machinery; manatee and dugong oil and dog oil in the manufacture of kid gloves. From many of these fine soaps are made. Some of our perfumes are obtained from certain animals —as the muskrat, musk ox, civet cat, musk deer, and beaver.

The artist looks to various animals for fine colorings. Ivory black, used in the manufacture of bank-note ink and in fine paintings, comes from bones; while Prussian blue is made from hoofs and refuse hair. The gall produces a dye, and from blood comes the turkey red of printers. The chemist depends upon animals to a large extent. Portions of the dog are used in tanning hides; albumin of the blood in refining sugar and various secretions in printing calico; while the chemist finds pepsin in the stomach of hogs and calves. Phosphorus for matches is taken from bones; the physician obtains his vaccine lymph from cows, by this means saving thousands of lives; while ammonia and lime are common products from bones and horn.

Among the special animals that are of great value to man is the whale. In 1884 a single animal sold for over fifteen thousand dollars, the oil bringing $3,490, the bone $12,230. Besides these products there is the ambergris, a secretion in the intestine; the valuable ivory of the teeth used by the Japanese in their carving; the skin as leather; the bones for knife handles and for various purposes.

The delicate mole is a valuable aid to the agriculturist. An individual will eat twenty thousand grubs in a year, while the fur is highly esteemed. The fur dealers use nearly ten million skins of rabbits and hares a year. Twenty thousand bears are sacrificed yearly, the hides being employed as leather, and even teeth for Indian chisels, knives, and ornaments. In 1880 the trade absorbed seven hundred tons of elephant ivory, one hundred thousand of these noble animals being killed that we might have billiard balls, chessmen, carved figures, and countless other objects for use and ornament.

The furs of animals keep us warm in winter, while the wool of our under-garments comes from another group representing vast industries giving support to thousands of persons.

Statistics in which this paper abounds are dry and uninteresting, but they alone tell the story of man's dependence upon the lower animals. One hundred thousand Persian lambskins are used annually by the trade; six hundred thousand Astrakhans and two hundred English skins—suggestive of an array of workers.

From the goat come mohair, cashmere; while the interesting Angora goat, which has been introduced into California, produces fifteen million pounds of wool per annum; every hoof, hide, and horn has its value in the great world of trade. The camels and their allies produce the hair for shawls and other valuable articles of wear.

The demand for objects of luxury is tending to the extinction of some of our most valuable animals. The buffalo has been almost wiped from the face of the earth, that we might have sport, robes, and buffalo tongue. The five hundred lion skins which the trade uses annually for rugs and leather have marked the royal cat for early extinction; while the rhinoceros, giraffe, tiger, elephant, and many more will doubtless be known to our descendants a century hence by their pictures in books and their remains in the museums of the day.

This great question of the economic value of animals is of radical importance to every citizen. It should secure our thoughtful attention, and be taught in our schools and colleges. We should demand from the Government absolute protection to the fur seal; our humane societies, which have accomplished so much, should extend their good offices to the protection of song birds, the wild game of our forests, and to all animal life.

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SKETCH OF LOUIS FIGUIER.

By IDA M. TARBELL.

WHO in America, reading twenty years ago, does not remember The World before the Deluge? It was translated from French into English at a time when the great call in our schools was for more science; when the ministers in numbers of pulpits were "reconciling Genesis with geology," and when boys and girls of fifteen were observing strata and fossil plants and animals as they never had before. Its direct statements, its vivid pictures, above all its exciting reconstructions of primitive epochs—a Silurian age whose principal inhabitant was a tranquil trilobite; a carboniferous era rich in giant ferns and "horsetails"; a Jurassic, whose terrible denizens, ichthyosaurus, plesiosaurus, pterodactyl, haunted the dreams—caused it to be read by hundreds of young people. There are many men and women in America who can trace their first interest in geology to that work, or to some one of those in the series to which it belonged.

The author of The World before the Deluge, M. Louis Figuier, it was my fortune to meet frequently in the winter of 1893 and '94 in his home in Paris, and the announcement of his death a few months ago led me to believe that many American readers might be interested in the recollections I have of our conversations and in the impressions his curious personality made upon me. M. Figuier was one of those men whom the popular fancy had wearied of and dropped, and who, unable to understand why he was not as thoroughly in touch with his generation as ever, insisted tenaciously on being heard.

The modest apartment of M. Figuier, like the house, was of a past generation. Its vestibule, whose walls were covered with the light striped paper in vogue long ago, and hung with family portraits in fading crayon and water colors, was furnished with an ancient hat tree. Its *salon*, carpeted with a dark-green Brussels, such as was in style in the United States perhaps forty years ago, was decorated with numbers of flower pieces, huge wreaths and bouquets, after the manner in which our mothers did their water colors. They were framed in narrow black or gilt moldings, and some of them still bore in the corner the numbers they had borne in the *salons* of the sixties.

As for M. Figuier, he had all the alertness, the decision, the energy of the life which surged all about and invaded the street in which he dwelt. In spite of his seventy-five years his form was tall and straight; his bearing was that of an officer rather than that of a writer; in his white face was none of the effacement of character so often seen in the old, no letting down of moral and physical self-control; his eye was ardent, indignant, sad by turns; his speech eloquent, rapid, full of conviction, impatient of contradiction. Yet one saw that he was, like the old houses of the Rue Caumartin, "condemned." His bitter protest against the way in which the journalism of the day treats the popularization of science, his persistency in regarding himself as the one and only popularizer; his despair at the good-natured raillery which the hobbies of his old age had called out, all showed that M. Figuier was out of touch. This mingling of generations, this refusal to believe that his work was done, gave me from the first of our acquaintance an interest in the fine old man which was half pathetic, half humorous.

I have never known a person whose origin and early education were more evident. He proved his southern birth—he was a Languedocian—by his fervor, his imagination, his astonishing plans. He showed his Huguenot parentage by the strength of his convictions.

But these things did not explain why, at thirty years of age, he should have left an excellent position as a professor, after having spent years in the universities of Montpellier and Paris preparing for it, and after having begun and succeeded in original investigations, to become a popularizer of science.

It struck me that a man of his evident pride and culture would have a justifiable satisfaction in remaining among *savants* and in pursuing the conventional path of university work, especially after he had acquired a sure footing. Why did not M. Figuier accept the scholar's career in which he was so well launched? Why did he take up popularization? I asked him one day.

"It was simple enough," he said. "It is true I had taken my degrees and had a good position, but I had the idea that scientific knowledge, which until then had been almost exclusively the property of the learned, should be put within the reach of the reading public, that the people should be enabled to share the fruits of scholarship.

"I was convinced that no one should attempt to do this sort of work but a man of thorough scientific training. I had done all the work the schools offered. I had been a professor. I had made some original researches. I felt that I had a right to attempt to explain in a popular style the wonders of science. My first book, on the Principal Modern Scientific Discoveries, was a success, and I immediately arranged to continue the work. My colleagues blamed me, and said I was belittling science, but I was convinced the thing ought to be done, and I made up my mind to do it if possible.

"In 1855 I began to write scientific letters for *La Presse*, which under Émile de Girardin was one of the most important papers of Paris. But I soon found I had too much to do. The university or the popularization must be given up. I chose the latter. There were plenty of men willing to do the exclusive work of the former; there was only myself willing to use my training for the press. And that is how I became a journalist."

He never referred to his early journalistic experience without recalling the brilliant circle which he entered when he became a member of the staff of *La Presse*. It needed only the suggestion of a name then to get his characterization of many a famous man or woman. He would clasp his hands and lift his eyes. "Ah, those were great days! Victor Hugo was living then, you know. The year I joined the staff of *La Presse* Théophile Gautier was doing its dramatic work, Lamartine was running his Cæsar as a *feuilleton*, and George Sand the Story of her Life. It was around such a nucleus that the Girardins gathered all that was brilliant in Paris into their *hôtel* in the Champs Elysées."

M. Figuier continued writing popular scientific books after he began journalism. The familiar *Année Scientifique*, which he conducted till the end of his life, was his first venture. It was followed by the Pictures of Nature, the first of which, The World before the Deluge, has been alluded to. This series incuded nine volumes, reviewing the meteorology, physics, mechanics, and chemistry of the globe.

One day when we were talking about the books he said: "I had an ambitious idea in beginning that series. I wanted to chase lying out of the schools."

"Lying?"

"Yes, lying. What are mythology and fables but lying?"

"But——"

"False, all false."

M. Figuier never allowed me to oppose him. He rose and took down one of the volumes, opened to a preface, and read me with many a gesture and with increasing warmth of tone the following observations:

"The first book to put into the hands of a child should treat of natural history. Instead of calling the attention of young minds to the fables of La Fontaine, the adventures of Puss in Boots, or the Twelve Labors of Hercules, they should be directed to the simple and naïve pictures of Nature—the structure of a tree, the composition of a flower, the organs of animals, the perfection of crystalline forms. It is because the nourishment of the young has been falsehood that the present generation includes so many false, feeble, and irresolute minds.

"If I live a hundred years I shall never forget the frightful confusion into which the reading of my first book threw my young head. It was an abridgment of mythology; and you know what one finds there: Deucalion, who creates the human race by throwing stones over his shoulders; Jupiter, who cracks his skull and lets out Minerva and all her accessories; Venus, who one fine morning is born from the sea foam; old Saturn, with his vicious habit of eating his children; and all the rest of that Olympus where the gods and goddesses commit so many bad actions. How can the head of a four-year-old resist such an upsetting of common sense?"

And so M. Figuier wrote his nine big volumes. Unquestionably they have contributed to interesting the young, not alone of France but of a large part of the world, in the phenomena of Nature; and if they have not yet driven out La Fontaine, Perrault, Mother Goose, and the fascinating inhabitants of Olympus, they have at least entered into healthy competition with them.

His great hobby as a literary worker was system. "System, classification," he would repeat, "it is through them I have done my great work. Every note I take goes into its proper place. So with everything I own. You have asked for data of my life. I can give them to you without looking! See here!" He opened a drawer in a cabinet in the room, and out came a great bundle of clippings—press notices on his work, reviews of his books, sketches of his life. A goodly number of them were American.

"Yes," he said, regarding them with a frown, "I get press notices from America by paying an agency, but that is all. My books have been steadily reproduced there for thirty years. See here, notice after notice of my last book, Happiness beyond the Tomb, and I have been unable to get even a copy of the translation."

It was while pursuing his favorite subject of "system" that M. Figuier revealed to me the great passion of his life.

One day he had led me into the vestibule where there were two large cases running to the ceiling. They contained numberless boxes of notes, all labeled. Here were all the subjects M. Figuier treated. At a moment's notice he could have under his eye all that he had accumulated on any subject which interested him. While listening to his enthusiastic explanations I noticed on one shelf a number of neat manuscripts.

"What are these?" I asked.

"My theater," he said, with a tender regard. "There are the plays, mademoiselle, which are going to teach the world science as it was never taught before. There," he continued, warming, "is the greatest of all methods of scientific popularization. Nobody understands it; nobody supports it. The press will not recognize it. New ideas are choked to death in Paris by the jealousy of journalists. These plays have been represented before audiences which were wild with delight. Ah! but they are beautiful! But jealousy keeps them back."

"There is one on your countryman Franklin and electricity; here is another on how Morse got his appropriation bill through; here is one Bernhardt has read and promised me to play. She says it is superb, *superb*. It is on Catharine of Russia."

"And some of them have been given?"

"Nearly all, at my expense, understand. I believe it is one way to teach science to the people, and I mean to do all I can to push it. Here are two volumes of plays which I have put on at much cost. One season I hired a theater for a series of scientific matinées. Again I made a tour of the provinces with a troupe. I have given ten years of my life and spent my fortune for this idea. Once I lived in a *hôtel* in the Champs Elysées, now I am *here*." And he looked scornfully around the modest room with its faded air. "I have given it *all* for my theater."

The pain of the man was too intense, his earnestness too profound, for me to probe deeper into this defeated passion of his old age, and I waited until a free hour in the Bibliothèque Nationale gave me leisure to discover just what M. Figuier's theater was. I found it was just what he said—an attempt to teach science by means of the drama. He argued in this way:

"Works of popular science contribute to dissipating the popular superstitions, concerning thunder, for example; but the book is silent and cold. A theatrical representation which shows the spectator the physical phenomena connected with thunder and lightning, under a striking and material form, will impress much more deeply.

"Besides teaching the laws of the physical and natural sciences, scenes from the lives of celebrated *savants* should be represented. Instead of taking, for the hero of a play, Cromwell, Richelieu, Louis XIV, Mazarin, take Denis Papin, Gutenberg, Kepler, Benjamin Franklin, Robert Fulton. Before my time no one of these persons had been made the subject of a play, simply because dramatic authors are unfamiliar with the events in the lives of naturalists and physicists. Nevertheless, illustrious *savants* are just as good as political or military personages for dramas or comedies. A *savant* is a man. Like every man, he has had his hour of youth and of love, his moments of sorrow and of bitterness. Because he has enriched his age and country by an immortal work is he less interesting than an imaginary personage? There are in the different periods of the lives of all *savants* subjects for dramas or comedies, situations capable of moving, of exciting to laughter or to tears."

A word on a few of the plays of M. Figuier will show how he carried out this theory. Take the "Marriage of Franklin," which turns around the difficulties which Franklin had to surmount to secure Miss Deborah Read. The tricks which electricity plays at the last moment untie the complications. A complete series of the physical, mechanical, and physiological effects of thunder and lightning are worked into the play.

"Miss Telegraph" portrays the situation of Samuel F. B. Morse before the passage of the bill appropriating money for carrying on his experiments on the electric telegraph, and describes the means by which Miss Ellsworth succeeded in getting the bill through at the last moment.

"The Blood of the Turk" is a "Mr. Isaacs" situation, showing what may result from the infusion of foreign blood into the veins of an old man. The hero has been treated with the blood of a Turk, and finds himself in the extraordinary situation of being half the time a passionate, quarrelsome, amorous Oriental, the other half a weak old man without the courage to fight the duels the Turk has provoked, the appetite to eat the meals the Turk has ordered, the gayety to do the love-making for which the Turk has contracted.

The "Six Parts of the World," in the style of Jules Verne, characterizes the five continents of the globe and discovers a sixth. Dumont d'Urville is the hero, and his expeditions to the south pole form the plot of the play. Lessons on navigation and discoveries, on desert fevers and phosphorescent beetles, on the customs of Madagascar and Australian progress, on American business methods and the character of the lands at the south pole, are all included in five acts.

One day, some time after I made the acquaintance of M. Figuier's theater, I asked him if he believed his idea would be carried out in the future.

"I expect to carry it out myself," he said sturdily.

"Yourself?" I exclaimed.

"Oh, not here, not here," he said quickly. "Beyond the tomb. I may fail here, but I shall take it up again when I am dead. I am persuaded that it will be easy to carry out there this idea which has occupied me so seriously here. Do you suppose we are going to be idle there? Not at all. We are going to do what we loved to do here, and do it perfectly, as we have longed and dreamed to do it."

"Do you really believe that?"

"Believe it? Of course I believe it! Does one put into a book what he does not believe? I have put all that into *Les Bonheurs d'Outre-Tombe*. Does a man at my age talk of what he does not believe? At seventy-five one tells the truth.

"Why should I not believe it? Nature indicates a future life by all her transformations, common sense preaches it, common justice demands it, and if we live again we shall work. Do you suppose the good God is going to leave us with our aspirations unsatisfied? No. Victor Hugo is writing better romances than he ever wrote here, and De Musset better poetry." Then, glancing at the water colors on the walls, "My wife is going on with her pictures, and there I shall succeed with my theater. Why," he cried, with a passionate conviction which was almost awe-inspiring, "that belief is the consolation of my life!"

He based his theories of the future life on no religion. It is modern philosophy based on science and reason, which in his judgment promises a future life. But this promise is only to the upright, who in this world practice righteousness and cultivate their minds. They after death take on the attributes of superior beings—that is, become what M. Figuier calls "*êtres surhumains*," or, in ecclesiastical parlance, angels.

On escaping from the body the new being becomes an inhabitant of the interplanetary spaces. Here all his faculties are quickened to an extraordinary degree, the secrets of Nature are clear to him, social problems are solved, all those whom he has loved on earth and who have died join him. The natural gifts which he has had no opportunity to cultivate on earth have full play there. Unfinished work is completed. He is in relation with the great and wise of all the ages. If he continues in this new sphere to do good and to cultivate his intellect—that is, if he works to raise his soul to perfection—he will be advanced to a superior realm of the sky, where the beings are of a still higher intellectual capacity and possess more numerous faculties.

As he loses more and more of the material element, he ascends higher in the scale of the elect. After passing two series of these celestial progressions and promotions, of which it is impossible to know either the number or the length, the soul arrives at a state of pure essence, and penetrates into the center of our solar system, the sun, whose inhabitants, possessing immortality, form a part of the divine government ruling over this portion of the astronomical system.

To merit such superior happiness man must apply himself during his life on earth to perfecting himself, to purifying his soul, loving his neighbor, spreading happiness about him, increasing his knowledge. He who, on the contrary, perseveres in injustice and ignorance will be condemned to recommence his earthly career, and that again and again until he is fit to leave this globe.

One attractive feature of M. Figuier's interplanetary heaven which he develops in his book is the novel means of travel he imagines to exist there. "Since science," he writes, "excuses itself from explaining the nature of the comets and the rôle they play in the universe, it is permitted to the imagination to say a word on the subject.

"Is it forbidden to believe that certain comets, notably those that return into our solar system, are agglomerations of superhuman beings which have just finished a voyage in the profound depths of the sky and end their trip by returning into the sun? According to this hypothesis, these comets are pleasure trains made up of the inhabitants of ethereal spaces."

In the last conversation I ever had with him I asked him, just as I was about to say good-by, "M. Figuier, do you really believe in your comets made up of souls?"

His stern face lighted up. "Ah, my excursion trains! Who knows? who knows? Perhaps I shall travel in one. But that, you know, is imagination."

And when we rose to leave the *salon*, and I stopped to regard for the last time the gay wreaths and bouquets on the walls, he added with a nod of complete conviction, "But of one thing I am sure—there I shall succeed with my scientific theater."

M. VALLOT'S observatory, on the Rocher des Bosses, Mont Blanc, about fourteen thousand five hundred feet above the sea, has developed into a really comfortable abode of eight rooms, furnished with adequate means of keeping out the cold and the snow and with conveniences for housekeeping. The walls and windows and outer door are double. The house has a kitchen and shop near the entrance; a room for guides, with five beds; a provision room; a director's room, with two beds; a registering room; a photograph and spectroscope room; a guest chamber, with three beds; and a physical laboratory. A peculiarity of the kitchen utensils is the construction of the kettles to compensate for the lowered boiling point of the mountain height. The observatory, instituted in 1890, was at first devoted to meteorology; but since the new observatory was erected on the summit, more attention has been given in it to terrestrial physics.

Editor's Table.

MEETING OF THE AMERICAN ASSOCIATION AT DETROIT.

THE American Association for the Advancement of Science had a very pleasant meeting at Detroit. Socially it was all that could be desired, and was perhaps in this respect among the best in the history of the body. The people of Detroit, who call their town "the Convention City," and are proud of the hospitality they show to the assemblies that visit them, strove to outdo themselves in entertaining their guests, and, what with the lunches they served and the receptions and excursions they gave, made the occasion a brilliant one. The high-school building, in which the association met, was one of the best it has occupied, for it amply accommodated all the meetings and furnished room for doing all the work under one roof.

The association suffered from the absence of its designated president, Prof. Wolcott Gibbs, who was kept at home by illness. His presence would have lent it much dignity, and would have recalled its older and best days. His place was taken by Vice-President McGee, who discharged the executive and administrative duties of the office satisfactorily. A happy feature in the opening meeting was the felicitous address of General Palmer, who, although not a man of science, evidently appreciated its value, and knew well how to fit his remarks to the occasion. The memorial address on Prof. Cope, by Prof. Theodore Gill, was perhaps the feature of the whole meeting which most deserves notice and will be remembered longest. The president's address and the addresses of the chairmen of the sections were well-wrought-out presentations of their several subjects, creditable to the speakers and to the association. Of the papers, the majority appear to have been technical. Of the others, some were very good, and some, we are constrained to say, should have no place in the proceedings of such a body as the association ought to be.

The attendance was not large; the whole number of registered members being only two hundred and ninety-one.

An important new step was taken in making the nomination of officers by the council and its nominating committee valid without further proceedings. Heretofore the nominations have been subject to approval by the association. The joint meetings of affiliated societies with sections of the association, of which there were several, were a feature to be commended.

The meeting made more prominent the fact which has been evident for many years, that our strongest and most experienced men of science are losing their interest in the association. They seem to have all the field for work and distinction they want in their own separate organization, which does not reach the people at all; while this field, in which they could gain quite as much repute, add fully as much to knowledge, and contribute vastly more to its diffusion, they neglect. It is hard to conceive a nobler or more desirable way in which the student of Nature can contribute to the instruction and elevation of his fellow-men than by giving his support to this body which courts the sympathy of the people, and by going from place to place seeks to instruct them in their very homes in the highest achievements of research. There can hardly be a more effective way of promoting the advancement of science than by these meetings, now here and now there, through which the beauties of knowledge are disclosed to the public, and the thirst for its acquisition and extension is aroused in whole communities at a time. The greatest scientific lights of Great Britain, France, and Germany love to do this. Thus, at the meeting of the British Association just held at Toronto, we have seen such men as Lord Kelvin and Lord Lister, Sir John Evans, and a dozen others of almost corresponding prominence, present, as interested and taking as active a part as if they were younger men still having their spurs to win. Other men, in their respective days of equal standing in science with these, whose books are standard authorities wherever the English language is spoken, have habitually attended the previous meetings of this body because their heart is in the work of making the whole world sharers in the benefit of what they have been able to discover. We can not but think that the eminent students of America who fail to do likewise are committing a great mistake.

THE TORONTO MEETING OF THE BRITISH ASSOCIATION.

The British Association for the Advancement of Science has now, for the second time, held an annual meeting on this continent. In the year 1884 it met at Montreal; this year it met at Toronto. The Montreal meeting was not, on the whole, considered a very successful or in any way notable one; but this year conditions and circumstances seem to have proved more favorable, and we believe the Toronto meeting will be remembered with much satisfaction by all who took part in it. Toronto, as a city, is well adapted for convention purposes, and the noble grounds and buildings of Toronto University formed a most admirable and charming focus for the work of a learned assembly. The visitors were favored also with the very finest weather which the climate of this continent is capable of producing; and that helped not a little to put every one in good spirits and give animation to the proceedings. Great names were not wanting amid the throng. The retiring president, Lord Lister, whose name all the world honors, was there to hand over his office to the distinguished archæologist Sir John Evans. To see Lord Lister and hear the tones of his voice is to recognize in him the friend of human kind—a noble example at once of scientific eminence and moral greatness. Lord Kelvin, too, was there with his earnest, kindly, unassuming manner and wonderfully penetrating intelligence—a man who bears his great honors meekly, as becomes one whose fame rests upon a sure foundation. Michael Foster was also present, a man who has trained and inspired with something of his own zeal a whole generation of physiologists at the University of Cambridge. Biology was further represented by such men as Profs. L. C. Miall and Lloyd Morgan; physics, by Oliver Lodge and Sylvanus Thompson; chemistry, by Prof. W. Ramsay, of argon fame; geography, by Mr. J. Scott Keltie; political science, by the Right Hon. W. Bryce, author of The American Commonwealth. We name but a few; there were men of eminence and merit on every hand.

Associated with their scientific brethren from England, and taking a prominent part in the proceedings of the association, were many of the foremost scientific workers in this country. Among these may be mentioned Profs. Morse, Newcomb, Remsen, Hadley, Putnam, and Chamberlin. A few associate members came from foreign countries. The Canadians contributed their quota of men of distinction, and altogether the gathering partook to a pleasing extent of an international character.

As usual, on such occasions, liberal provision of time was made for social hospitalities and semiscientific excursions; but the serious business of the association was well kept in view. The inaugural address of the incoming president, Sir John Evans, consisted of a plea for the recognition of archæology as entitled to a place among the sciences. He had no difficulty in showing the aid which the archæologist is able at times to render to the geologist, and also the assistance it affords toward a scientific treatment of history. His account of the evidence accumulated within the last thirty or forty years as to the antiquity of the human race was clear and succinct. He did not consider the existence of man in Miocene times proved, but he spoke of the "almost incredible length of time" occupied by the Palæolithic period. "We may not know," he said, "the exact geological period when palæolithic man first settled in Britain; but we have good evidence that he occupied it at a time when the configuration of the surface was entirely different from what it is at present; when the river valleys had not been cut down to anything like their existing depth; and when the fauna of the country was of a totally different character from that of the present day." The time covered by that period was sufficient, he stated, to permit of "the erosion of valleys, miles in width, to a depth of from one hundred to one hundred and fifty feet. . . . When we take into consideration," he added, "the almost inconceivable ages that, even under the most favorable conditions, the excavation of wide and deep valleys by river action implies, the remoteness of the date at which the Palæolithic period had its beginning almost transcends our powers of imagination." Sir John Evans speaks with the authority of a man deeply versed in geology as well as in archæology, and it is safe to assume that he speaks within bounds.

Among the Presidential Addresses to the Sections were several that were weighty and valuable. Prof. Michael Foster reviewed most instructively the progress of physiological science in the dozen years that had elapsed since the association had last met in Canada. He sounded a not unneeded note of warning against allowing commercial considerations to predominate in questions of research. "There is an increasing risk," he declared, "of men undertaking a research not because a question is crying out to them to be answered, but in the hope that the publication of their results may win for them a lucrative post." A greater evil still, he considered, was the locking up of scientific discoveries for the private enrichment of the men who had made them. Another observation of general value was to the effect that scientific controversy is never wholly valueless, since "the tribunal to which the combatants of both sides appeal is sure to give a true judgment in the end." The great progress, he stated, that had been made in the study of the conditions and aspects of life in the higher animal forms had rendered much more hopeful the study of life in its lowest and most generalized forms; so that there is good reason to anticipate that "in the immediately near future a notable advance will be made in our grasp of the nature of that varying collection of molecular conditions, potencies, and changes, slimy hitherto to the intellectual no less than to the physical touch, which we are in the habit of denoting by the word protoplasm." Here "the animal physiologist touches hands with the botanist, and both find that under different names they are striving toward the same end." The learned professor recognized that it would be inopportune "to plunge into the deep waters of the relation which the body bears to the mind," but this, he declared, we know, "that changes in what we call the body bring about changes in what we call the mind." If, therefore, in the coming years a clearer knowledge shall be gained of "the nature and conditions of that molecular dance which is to us the token of nervous action," and if "a fuller, exacter knowledge of the laws which govern the sweep of nervous impulses along fiber and cell give us wider and directer command over the molding of the growing nervous mechanism and the maintenance and regulation of the grown one, then assuredly physiology will take its place as a judge of appeal in questions not only of the body but of the mind; it will raise its voice not in the hospital and consulting room only, but also in the senate and the school." These are eloquent words, but their eloquence is the least part of their merit; the preponderant part lies in the truth they contain—a truth which at this very moment it has become urgently necessary to proclaim in face of the fanatical doctrines of the absolute supremacy of mind or spirit which are running like wildfire through certain sections of supposedly educated communities.

Wherever scientific men congregate there the name of Darwin is sure to be mentioned with honor. Prof. Foster, in the address to which we have just referred, spoke of his "pregnant ideas" as having "swayed physiology in the limited sense of that word as well as that broader study of living beings which we sometimes call biology, as indeed they have every branch of natural knowledge." The President of the Anthropological Section, Sir William Turner, spoke of the "enormous impulse given to the study of the anatomy of man in comparison with the lower animals by Charles Darwin's ever-memorable treatise on the Origin of Species." According to the President of the Botanical Section, Prof. Marshall Ward, whose address yielded to none in the wealth of interesting facts and principles it unfolded, recent comparative studies, both of existing and of fossil plants, "are yielding at every turn new building stones and explanatory charts of the edifice of evolution on the lines laid down by Darwin." Not less ample were the acknowledgments of the value of Darwin's work made by Prof. Miall, President of the Zoölogical Section. "I do not," he said, "lay it down as an article of the scientific faith that Darwin's theories are to be taken as true; we shall refute any or all of them as soon as we know how; but it is a great thing that he raised so many questions that were well worth raising. He set all scientific minds fermenting, and not only zoölogy and botany, but paleontology, history, and even philology bear some mark of his activity. We owe as many discoveries to his sympathy with living Nature as to his exactness or his candor, though these two were illustrious. A young student anxious to be useful may feel sure that he is not wasting his time if he is collecting or verifying facts which would have helped Darwin."

Apart from his reference to Darwin, there were many interesting and valuable observations in Prof. Miall's address. He dwelt with proper force on the impossibility of obtaining a living insight into biological problems or even a living acquaintance with biological facts by means of text-books and lectures alone. He indicated the necessity of extreme care in talking of the "laws of Nature," lest some false idea of a positive mandate should creep into the mind. He expressed himself as accepting in great measure, but still in part only, the "recapitulationist" theory, as it has been called, of embryonic development. He believes that the mammalia certainly had a piscine origin in remote ages, but professed himself unable to trace their family record any further back. He does not like the word *must* in the mouth of a biologist. "Whenever any biologist brings the word *must* into his statement of the operations of living Nature, I look out to see whether he will not shortly fall into trouble."

Upon the whole, there was much useful work accomplished at the Toronto meeting. One could not attend the different sections without feeling that the work of science in its different branches is a great and mighty and beneficent work, and one which elevates and liberalizes the minds that give themselves to it with devotion. However lightly these annual gatherings may sometimes be spoken of as being mainly occasions for holiday-making, we believe that they are the means of communicating many useful intellectual impulses both to the working members themselves and to the general public.

Scientific Literature.

SPECIAL BOOKS.

In this fifth volume of the Memoirs of the American Folklore Society are given what might be called the book of Genesis of the Navaho Indians and the shorter legends of Natinesthani and The Great Shell of Kintyel.* The origin legend starts with twelve insect peoples and tells how First Man and First Woman were produced by the gods and cared for by the insect peoples as the gods directed. The history of this pair and of their descendants follows and is filled with incidents designed to explain present customs of the Navahoes and various phenomena of Nature. The last chapter of the legend, dealing with the growth of the Navaho nation, is in part traditional or historical, and many of its dates are approximately correct. The introduction of sixty pages which Dr. Matthews has prefixed to the legends, and his sixty-five pages of notes, contain much material of value to the anthropologist. The Navaho reservation lies in the northern parts of Arizona and New Mexico, and although arid is not a desert. Dr. Matthews tells us how the Indians manage to raise meager crops from its soil, and how they care for their herds of sheep and goats. He also describes the personal appearance of this rather intelligent people and the structure of their various kinds of dwellings, giving portraits of several individuals and views of typical houses. Their industries—weaving, in which they excel, basket making, pottery, silverwork, etc.—are described, with pictures of specimens and of Indians at work. Dr. Matthews gives us also some description of the Navaho religion and its ceremonies. The religion is an elaborate pagan cult, and as the tribe inclines to be democratic so does the pantheon: they have no highest chief, so they have no supreme god. There are also evil spirits whom men dread. Many of the ceremonies are of nine days' duration, while others last but a single day or a few hours. Elaborate costumes and other paraphernalia are employed in them, specimens of which are here figured. To learn one of the great rites so as to become its chanter, or priest, is the work of many years. Dr. Matthews has a good word for the medicine men that he has come in contact with among this people. Among the notes are given the words of several songs with interlinear translations, and the music of eleven melodies, the latter having been recorded on the phonograph by Dr. Matthews and noted from the cylinders by John C. Fillmore. In addition to its forty-two cuts in the text the volume contains four plates, of which two are colored.

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* Navaho Legends. Collected and translated by Washington Matthews, M. D., LL. D. Boston: Houghton, Mifflin & Co. Pp. 299, 8vo. Price, $6.

Mr. Bellamy's *Equality* * takes up the story and the discussion of social questions from where Looking Backward ended, and continues them. It is in the year 2000, and in the conversation in the garden where Looking Backward left the pair, Edith asks Julian West about the old times of the nineteenth century, and is astonished that such things as he tells of could have been. Some of the details of the revolution that changed conditions are explained to him. He opens his account in the National Bank and learns about the new financial system, in which private estates are extinguished, the nation owns all the property, and every citizen is allowed each year an equal credit, in lieu of estate, wages, or profit. Every one is expected to choose some occupation and follow it, and all are expected to do by turns their shares of the unpleasant work which no one chooses. A remedy is described for those who refuse to take their privilege or burden. In all those things, and in dress, women are as men, and changes of fashion are no longer known. A discussion of right of property introduces an elucidation of the theory of the social fund and the doctrine that private capital is stolen from it, and the astonishing declaration that under the system prevailing in the nineteenth century, if one monopolist could have acquired title deeds to all of the earth, he might have ordered the human race off of it. The right of title by inheritance is attacked, but it is argued that the equalization of human interests achieved does not destroy the right of property. It is simply merged in the title of the state. And it is held that by this system of equalization women are delivered from a bondage incomparably more complete and abject than any to which men have been subjected by their fellow-men—the bondage of personal subjection to the husband, and to the tyranny of conventional rules. The profit system is held up as one of economic suicide. Strikers of the nineteenth century are honored in statuary as the leaders in the revolt against capitalism and the pioneers in the new movement. Julian finds that what he had formerly thought evil has become good, and what has seemed wisdom has become foolishness. The iniquity of foreign commerce for profit and the hostility to improvement of a system of vested interests are enlarged upon. While under the old system the continued acquisition of knowledge after leaving school was prevented by the burden of cares that fell upon the man going into business for profit, in the new society the state assumes that burden, and the man can keep on learning all the time. By a constant and immediate referendum the people are able to keep their legislatures under direct and instant control. War no longer exists. The new patriotism looks to the character and purity of the people. Foreign trade is diminished and foreign travel for knowledge increased. Hygienic development has improved doctors out of their occupation. Meat is no longer eaten. Population is distributed out of the cities over the country. The forests have been restored. Farming is done by machinery. The last chapters comprise the history of the supposed revolution, which is assumed to have begun in a revolt against the corruption and monopolies of the nineteenth century and of the solution of the problems it raised.

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* Equality. By Edward Bellamy. New York: D. Appleton and Company. Pp. 412. Price, $1.25.

We wake from the reading of the book to find that we are still in the nineteenth century, suffering from all its faults.

The popular idea of Russia is that of a country inhabited by two classes: first, the military and civil minions of the Czar, who carry out the oppressive edicts of their master with fierce satisfaction; and, second, the people, who submit to this tyranny in constant sullen fear, the brightest among them being generally occupied with plots of assassination. A moment's reflection ought to convince any intelligent person that there is another side to the shield, but everybody does not stop to reflect. The book before us shows the other side.* Mr. *Logan* had a good time in Russia, and he saw many thousands of Russians having a good time. He attended the coronation ceremonies as one of the diplomatic party from the United States, and, although this brought him in contact only with the official and noble class, who have reason to be contented, one could not go about as much as he did at a time when the common people thronged to the splendid ceremonials without seeing a great deal that throws light upon the real condition of "Ivan," the peasant. Mr. Logan recounts the incidents of travel, and describes the stores, streets, conveyances, and other things that one sees in passing with a humor and unconventionality that are delightful. He has grouped many of his observations by subjects. Thus, in a chapter on The Breaking of Russian Bread, he describes the diet and the dishes of both nobles and peasants, with digressions on hunting and fishing. There is much French cookery in Russia, and there are also many distinctively native dishes, some of which Mr. Logan is able to praise enthusiastically. Other chapters describe a village of peasants, Russian horses, the Russian church, Slavic art and literature, and tell "How we kept house" and "How we washed in Russia." The bath-tub of America is a stranger to Russian domiciles, but there are public establishments where the real Russian bath is enjoyed by all classes of the population. In every village there is a bath-house in which the peasants steam themselves at least once a week. But the chief subject of the volume is the coronation ceremonies. Mr. Logan portrays for us the splendid processions, the impressive ceremonies, and the magnificent banquets, balls, and performances. He and his friend "G——" were blest with a courier who was constantly making mistakes that brought them into better positions than they were entitled to.

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* In Joyful Russia. By John A. Logan, Jr. New York: D. Appleton and Company. Pp. 275, 12mo. Price, $3.50.

In this way they saw the imperial infant and passed through the throne room, where the crown jewels were displayed, on the day of the coronation. They were put out of this room with a courtesy that they found everywhere unfailing among Russian officials—an officer chatted with them a few moments, and then politely offered to send some one to show them the way to the diplomatic tribune. Mr. Logan tells also of the feast, the juggling shows, and other things suited to their tastes that were provided for the common people. He finds that the lower classes have many privileges and a great deal of liberty, and that they have as intense a loyalty as their heavy natures are capable of. The occurrence at the people's *fête* on the Khodynskoe Plain, which threw the only cloud over the joyousness of the coronation, was not an unmixed evil, for it gave Nicholas II an opportunity to show kindness to his people that justified them in calling him "the Little Father." There is much more in this book than we have space to enumerate. The illustrations deserve more than the word we can give them. There are nearly fifty pictures of buildings, interiors, distinguished personages, and types of the population, besides which there are colored portraits of the emperor and empress and views of the cathedrals of St. Basil and of the Assumption in Moscow.

GENERAL NOTICES.

*An Experiment in Education** is a suggestive little volume setting forth, in about two hundred and fifty pages, the experiment of a thoughtful teacher in introducing young children at once into the elements of knowledge along novel lines of instruction; and it touches furthermore on the principles underlying the experiment. Readers of Appletons' Popular Science Monthly are already familiar with the main ideas of the book, two of the chapters dealing with the actual experiment in Boston and in Englewood, Ill, having appeared as separate papers in previous issues of the magazine. The author, after teaching for ten years in high and normal schools, found that from "one half to one third of the time allotted to a subject had been spent in teaching the student how to use his mind, to use books, specimens, etc.—in other words, how to study. This waste was irritating and pitiable in view of the short time allowed to subjects, and I could not be reconciled to the notion that an adult mind must so generally lack power to work economically, trustworthily, and discriminatingly." To overcome this deficiency, and to ingrain into the mind of the child from the very start habits of accurate observation and independence of judgment, became the object of the teacher; and natural-science studies, as lending themselves most readily to object lessons, where the child could be taught to observe facts and to verify his experience, were made the basis of instruction. Reading and writing were taught by means of the blackboard, and the children constructed their own primers and copy-books out of the material drawn from their science lessons. Thus, instead of wasting time over the mere tools of learning or trite facts of everyday life, they from the very start became familiar with the elements of knowledge. In place of text-books, the Socratic method was applied—drawing out of the children by skillful questioning the facts they were to observe. Instead of taxing the memory with useless lumber, the eye was trained to see and the mind to form independent judgments. The experiment in Boston was made with the children of the primary department in a private school, and was highly successful as far as it went. That the principles could be equally well applied to larger classes was proved in some of the public schools of Englewood, Ill., where they found enthusiastic adherents in many of the teachers.

The ideas underlying the experiment are explained in the second part of the book, and are in sum that "children must at once be introduced to real knowledge, be given something worth their efforts, and treated as rational human beings, who ought not, even if they could, be made to greatly care for the symbols and shows of learning in the absence of the real substance, nor led to imagine that they were being mentally and morally nourished—that is, educated—when fed on chaff mainly." This part deals with the Quality of Studies, the Order of Studies, the Effects of Studies, and the Ends to be served by Studies—all with the view of producing a fully rounded, keen-eyed, alert, and self-dependent man or woman, able to do his share in the world's work, and to fill his place in the social order—in short, to attain to his highest development while fully sympathizing with the endeavors of his fellows. The doers of mankind are to be developed; the dreamers find no place in the author's scheme of education.

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* An Experiment in Education, also the Ideas which Inspired it and were Inspired by it. By Mary R. Alling-Aber. New York: Harper & Brothers, 1897. Price, $1.25.

Part III gives some details about the teaching of special subjects, including Science, History, Literature, Language, Mathematics, Industrial Training, Means of Expression, and a chapter for mothers entitled At Home, indicating in what ways a mother may awaken her child's powers of observation. Part IV gives some suggestions about the atmosphere of the schoolroom. The experiment was made in 1881, when "natural-science studies had not been made an integral part of any primary schoolroom, and literature and history in such grades were mostly unthought of." Long strides in advance have of course been made in the sixteen years intervening; still, the book can not fail to arouse into more thoughtful activity many teachers, and it should especially appeal to mothers and to educators who advocate individual instruction. What may by some be considered an objection to the system is that it makes enormous demands on the ingenuity of the teacher, for in place of the routine of the schoolroom it puts individual thinking.

Mr. Moore's brief treatise on the *Philosophy of Art** is a thoughtful study, by a man who has had time and opportunity to give full attention to the subject from the literary rather than the evolutional point of view, of the origin and nature of the arts, which he classifies as those appealing to the sight and to the hearing. The author regards them all as primarily the outgrowth of necessity, and esteems as the most interesting feature of his inquiry the paradoxical nature of the transition from the original condition and purposes of art to its later and present uses.

A new work on geology, both suitable for a college text-book and very attractive to the general reader, has been written by Prof. *Scott*, of Princeton.* The author's plan has been to make a book dealing principally with American geology, after the style of Sir Archibald Geikie's Class-Book. Its American character is a marked feature of the present work. It is clearly advantageous, the author remarks, that we should make use of our own country in selecting typical facts for study. Accordingly, the formations that he describes and figures are nearly all American. Prof. Scott has had the use of a great deal of material collected for the United States Geological Survey, and a large part of his nearly three hundred figures are reproduced from photographs taken for the survey. Prof. Scott does not make much use of diagrams, evidently preferring to show the reader the actual appearance of the examples that may be seen in the field. The value of field study is strongly emphasized by him. Dynamical geology is the first of the large divisions of the subject that he considers, beginning with igneous agencies, but for students who begin a study of the subject in the fall he advises taking up other chapters first. He makes a special division of the work under the title Physiographical Geology, in which he has three chapters dealing with the changes in topography effected by geological agencies, and the clews which topographical features give in tracing past geological operations. A little more than one third of the work is devoted to historical or stratigraphical geology. Here, while both American and foreign formations and fossils are described, the foreign are always placed in a separate paragraph after the American, with a distinctive heading. A table of the more important European formations is appended to the volume, but few of the subdivisions having been mentioned in the text. Another appendix contains the system of classification of the animals and plants which has been used in the book. There is a full index, and the mechanical execution of the volume is of a high order.

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* A Treatise on the Philosophy of Art. By D. R. Moore. St. John, N. B. Pp. 23.

* An Introduction to Geology. By William B. Scott. New York: The Macmillan Co. Pp. 573, 8vo. Price, $1.90.

Prof. *Storer's* work on the chemistry of agriculture, which first appeared in 1887 and was revised in 1892, has been again revised.* It is based on the lectures which the author has delivered at the Bussey Institution, a department of Harvard University, now for twenty-five years. The chemical nature and behavior toward plants of every substance that has been used to any extent as a fertilizer are set forth in these volumes. Other subjects discussed are the relations of water to the soil, the effects of tillage, rotation of crops, the management of hay and grain crops, the production of ensilage, etc. The additions that have been made in this edition, and the fact that it has been entirely reset in larger type, have necessitated printing the work in three volumes instead of two as heretofore.

The second volume of Britton and Brown's *Illustrated Flora of the Northern United States*,† etc., gives the families, genera, and species from Portulaca to the dogwoods and tupelos, seventy-two families, in *Choripetalæ;* and from the clethras to Buckbean, sixteen families, in *Gamopetalæ.* We have already indicated, in our notice of the first volume of this work, its general character and scope. We have to refer specially here chiefly to the pains which are taken to make the work as a whole and the particular descriptions plain to the most untechnical reader. Every species is figured as to general habits, leaf, flower, and fruit; English names are given or the botanical names are translated into meaning English for each family, genus, and species; and English measures are used, so that the plain student may conceive at once and as if with his eyes shut the dimension indicated without having to look at a scale or make a mathematical reduction. Complete indexes are provided of English and of Latin names.

Mr. Thayer's essay on the *Hebrews in Egypt and their Exodus** is an attempt to find if there be not in the Pentateuch a reasonably credible, historic narrative which may be accepted with as much confidence as any other chapter of history so ancient. The argument is, in brief, that, owing to the strong race feeling of the Jews, the genealogies of their families were the most carefully recorded and the most uniformly coherent, consistent, and jealously preserved part of their history; that here we shall find firm ground to stand on, if anywhere; that the annals of the Pharaohs as now accepted by Egyptologists support and confirm these genealogies; and through these is to be traced the real thread of historic truth. While the author does not hold to the usually accepted views concerning the Pentateuch, he has no sympathy with what is called the destructive school of criticism. His argument is, on the contrary, intended to be constructive and preservative.

"A practical treatise for practical men" is what Dr. *Louis Bell* has aimed to make his recent book on *Electric Power Transmission* (Johnston Co., $2.50). After some discussion of elementary electrical principles and transmission of power by other than electrical means, he gives a chapter to power transmission by continuous currents, which up to the present time is the commoner mode. He then takes up the coming mode of power transmission, namely, by alternating currents. He points out the properties of alternating circuits that have a direct bearing on power transmission, and discusses monophase, polyphase, and heterophase systems and the forms of apparatus used with each. A chapter is given to apparatus for changing alternating to direct currents or the reverse. Dr. Bell goes outside the strict limits of his title to treat of steam engines and of the development and use of water power. The organization of a power station, line construction, and the various problems of distribution, including the commercial problem, are all discussed in more or less detail. The volume contains over two hundred diagrams and other illustrations, including several half-tone plates.

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* Agriculture in Some of its Relations with Chemistry. By F. H. Storer. In three volumes. Seventh edition, revised and enlarged. New York: Charles Scribner's Sons. Price, $5, *net.*

† An Illustrated Flora of the Northern United States, Canada, and the British Possessions, from Newfoundland to the Parallel of the Southern Boundary of Virginia, and from the Atlantic Ocean Northward to the 102d Meridian. By Nathaniel Lord Britton and the Hon. Addison Brown. Vol. II. Portulacaceæ to Menyanthaceæ. Portulaca to Buckbean. New York: Charles Scribner's Sons. Pp. 643. Price, $3.

* The Hebrews in Egypt and their Exodus. By Alexander Wheelock Thayer. Peoria, Ill.: E. S. Willcox. Pp. 315. Price, $1.25.

The Macmillan Company has issued for Dr. *Charles B. Davenport* the first part of a work on *Experimental Morphology*, to be completed in four parts. This part is devoted to the effects of chemical and physical agents upon protoplasm as determined by experiments. The chief chemical agents whose influence on the vital actions of protoplasm is examined are oxygen, hydrogen, oxides of carbon, ammonia, and various poisons. Among the physical agents experimented with are the forces heat, light, and electricity; the effects of moisture and dryness, of different densities of the containing solution, of molar agents, and of gravity are also passed in review. The influence of each agent on the direction of locomotion of the protoplasm is among the effects considered. Following each chapter is a list of literature on the subject of the chapter. The work is designed as a contribution to the fundamental question, Why does an organism develop as it does? Of the two classes of causes that influence development, Dr. Davenport has confined himself to the external causes. The three parts of the work to follow will deal respectively with growth, cell division, and differentiation. (Price, $2.60.)

The United States Geological Survey is publishing a geologic map of the United States with a topographic base map. It is being issued in parts, called folios, each covering a small area. Thus the *Yellowstone National Park Folio* contains four topographic sheets, known as the Gallatin, Canyon, Lake, and Shoshone sheets, and four geologic sheets of the same districts. The scale is about half an inch to a mile, and the contour interval is one hundred feet. Contours and elevations are printed in brown, water courses in blue, and the works of man, such as roads, railroads, and towns, are printed in black. The geologic formations are indicated by systematic coloring. There are also eleven photo-engravings of views in the region covered, and six folio pages of description. The plan of the map is explained on the two inside cover pages. The Survey has a circular telling the prices at which the several parts are sold.

An atlas of *Illustrations showing Condition of Fur-seal Rookeries in 1895 and Method of Killing Seals* has been printed as a Senate document to accompany the report of C. H. Townsend. It contains forty-six plates, many of them folded, the greater part of which are views on St. Paul and St. George Islands, showing the seals on the beaches. Six plates show the processes of killing and skinning the seals.

In the *Fourteenth Annual Report of the Bureau of Ethnology*, covering the year 1892–'93, the director, Major *J. W. Powell*, describes the work of the year, which included investigations along a number of distinct lines. The immediate purpose in organizing this bureau was "the discovery of the relations among the native American tribes, to the end that amicable groups might be gathered on reservations. It was early found that classification by somatologic (physical) characters was useless for the purpose in view, while a grouping by language, governmental institutions, religion, industries, and arts brought together tribes who could live in proximity with little or no strife. In general, language alone will serve as a satisfactory basis for this practical grouping, and readers familiar with the previous publications of the bureau have noticed the large share of attention that has been given to Indian languages, both spoken and written in pictograph. The present report is accompanied by three extended papers. One of these, on The Menomini Indians, by Dr. Walter J. Hoffman, describes the ritual of the Mitawit (Grand Medicine Society), into which he was duly initiated, and gives a considerable collection of Menomini mythology and folklore, together with descriptions of many of the arts and customs of this tribe and a vocabulary of its language. The memoir is illustrated with many full-page plates and smaller cuts. The results of a historical research appear in a paper on The Coronado Expedition, 1540–'42, by George P. Winship, of Harvard University. This expedition was sent out by Mendoza, Governor of "New Spain," in southern Mexico, and discovered the Pueblo Indians of New Mexico, the Grand Cañon of the Colorado, and the bison of the great plains. Mr. Winship presents the original text of Coronado's report and an English translation, together with translations of shorter papers relating to the expedition, and a historical introduction giving the events which led up to this undertaking and the circumstances under which it was carried out. Many reproductions of sixteenth-century maps and modern pictures of Pueblo Indians and their dwellings accompany the memoir. The ghost dance, which has been for half a dozen years a word to inspire terror in reports from the Indian reservations, is described by James Mooney in his paper on The Ghost-dance Religion and the Sioux Outbreak of 1890. The dance is the manifestation of an epidemic of religious frenzy which was transmitted from tribe to tribe over one third of the area of the United States and then died away. Mr. Mooney accompanies his account with descriptions of similar rites among the Indians and similar frenzies among Christians and Mohammedans. The memoir is copiously illustrated.

Nearly two thirds of the volume containing the *Report of the United States Commissioner of Fish and Fisheries for 1895* is devoted to a Check List of the Fishes and Fishlike Vertebrates of North and Middle America, by Jordan and Evermann. Owing to ill health, the late Commissioner McDonald was unable to prepare a report, and the work of the year is shown in the reports of assistants. Several special investigations are described in appended papers.

The statistical matter in the eighth annual report of the *Interstate Commerce Commission on the Statistics of Railways in the United States* follows the same order and covers the same ground as in previous years. It yields many evidences of continued business depression, although there has been a net decrease of twenty-three in the number of roads in the hands of receivers. Special features of this report are, first, comparisons not only with the preceding year, but so far as possible with the years from 1890 to 1894 inclusive; second, the compilation of operating expenses for 1894 and 1895; and, third, the table showing revenue and density of traffic for all roads whose gross revenue exceeds $3,000,000 a year.

The aim of Appletons' Home-Reading Books evidently is to give young persons a broader view of the world in which their lives are to be passed than they can get from their school books. It is not necessary that all knowledge should be gained by drudgery over set tasks; much may be imparted by books like these, which interest at the same time that they inform. In the little volume on *The Plant World* which he has prepared for this series, Mr. *Frank Vincent* has made an excellent collection of the romances and realities of the botanical kingdom. He has taken from the writings of American and foreign naturalists selections describing plants remarkable for their beauty, size, peculiar form, or great usefulness, and has scattered among them a few tributes from the poets. Mr. Vincent has not sought for the remote or startling alone. He calls upon Bonifas-Guizot to tell the uses of the cocoanut tree, and Paul Marcoy to describe the Victoria Regia, but he has also something about common grasses by Margaret Plues, and includes Whittier's poem on the pumpkin. Mr. Vincent has been in every quarter of the globe himself, and may be depended upon to select only accurate descriptions of foreign plants. Fifteen full-page photo-engravings add to the attractiveness of the volume. (Appletons, 60 cents, *net.*)

Prof. *Edward L. Nichols*, already favorably known as an author of text books on physics, has produced an elementary work, under the title *The Outlines of Physics*, which is intended to be a fair equivalent for the year of advanced mathematics now required for entrance to many colleges (Macmillan, $1.40). In order to possess sufficient disciplinary value for this purpose, says the author, "physics must be taught by laboratory methods, and the experiments should be, as far as possible, of a quantitative nature." This book is designed as a text-book and a laboratory guide combined. "In the selection of the methods and of the apparatus used," Prof. Nichols continues, "I have always had in view the greatest possible directness and simplicity, rather than the highest degree of accuracy. The inexperience and the immaturity of the reader and the necessarily inadequate equipment of school laboratories have been likewise borne in mind." The applications of physics to the arts, which in some books are pointed to with pride, he has rigidly excluded. As in most elementary works, mechanics, being the simplest division of the science, comes first, and the chapter here includes something of hydrostatics and pneumatics. This is followed by heat; while electricity, often left till the last, comes third, being followed by sound and light. Practical directions on the use of apparatus are given in appendixes. Four hundred and fourteen cuts, nearly all from new drawings, illustrate the text.

The extraordinary activity in the determination of atomic weights since 1884, resulting in the accumulation of a great mass of new material, has led Prof. *F. W. Clarke* to prepare a revised and enlarged edition of his *Recalculation of the Atomic Weights.* It appears as Part V of the series of volumes on the constants of nature published by the Smithsonian Institution.

The small treatise on *Metals* in the Text-books of Science Series, a new edition of which has been prepared by *A. K. Huntington* and *W. G. McMillan*, is based on one by Bloxam published in 1872, and rewritten by Prof. Huntington in 1882 (Longmans, $2.50). Its aim is "to make clear the principles which have guided the evolution of the metallurgical arts and industries, avoiding multiplicity of detail, which tends to obscure main issues." The volume opens with an extended chapter on the characters and modes of preparing the various fuels used in metallurgy, from charcoal to water gas. Several forms of apparatus for producing or utilizing various kinds of gas are also described. This chapter is followed by a few pages on refractory materials and fluxes. In passing to the treatment of the various metals, their common properties are set forth and certain general processes for crushing, dressing, and roasting ores are described. Because of its importance iron is given first place, and nearly two thirds as much space is devoted to it as to all other metals together. The chief ores of iron are described, and something is told of the Catalan and other primitive smelting methods. The various processes in present use for the production of iron and steel are then described, particular care being given to stating the reasons for each step, and to telling the properties of combinations of iron with small quantities of other elements. The other metals used in the arts are similarly treated. Among the less common ones to which a page or two is given are cadmium, iridium, palladium, bismuth, magnesium, and sodium. Tables and a full index are appended. There are one hundred and twenty-two cuts of furnaces and other apparatus.

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Fragments of Science.

A Bunsen Burner for Acetylene.—An interesting item regarding the use of acetylene as a heating agent occurs in the Chemical News. A. E. Munby writes: "The cheap production of calcium carbide has placed a powerful illuminant within the reach of those who possess no gas supply, but so far little has been heard of the use of acetylene as a heating agent. Our laboratory is, so far as we know, the first to make use of the gas for this purpose. We employ a Bunsen burner of special dimensions, the tube being five millimetres in internal diameter. A slightly wider tube may be used, provided the mouth be curved inward, so that the actual exit does not exceed the diameter mentioned; if larger, the flame tends to strike down. The gas jet is very small, being only capable of delivering about one cubic foot of acetylene per hour under six inches water pressure, such a rate of consumption giving an ordinary working flame. The air holes and collar are arranged as in an ordinary Bunsen, the exact size of the former not being of much importance, provided they be large enough to admit the air required. A generator capable of giving gas under seven inches water pressure with the full number of burners in use is required. The heating effect of the flame is, of course, very great, enabling one to dispense with the blowpipe for some operations, such as small fusions. . . . It would seem that in practice, for equal volumes burned, the acetylene has nearly twice the heating power of coal gas."

Officers of the American Association.—At the recent Detroit meeting of the American Association for the Advancement of Science, Prof. F. W. Putnam resigned the office of Permanent Secretary, which he had held for about twenty-five years, and L. O. Howard, of the Department of Agriculture, Washington, was chosen to succeed him. The officers elect for the next meeting, which is to be held in Boston, are: President, Prof. F. W. Putnam; Vice-Presidents, Mathematics and Astronomy, E. E. Barnard; Physics, Frank P. Whitman; Chemistry, Edgar F. Smith; Mechanical Science and Engineering, M. E. Cooley; Geology and Geography, H. L. Fairchild; Zoölogy, A. S. Packard; Botany, W. F. Farlow; Anthropology, J. McKeen Cattell; Economic Science and Statistics, Archibald Blue (Toronto, Canada). The Sectional Secretaries are: Mathematics and Physics, Alexander Zirvet; Physics, E. B. Rosa; Chemistry, Charles Baskerville; Mechanical Science and Engineering, William S. Aldrich; Geology and Geography, Warren Upham; Zoölogy, C. W. Stilles; Botany, Erwin F. Smith; Anthropology, M. H. Saville; Economic Science and Statistics, Marcus Benjamin. D. S. Kellicott, Columbus, Ohio, was elected General Secretary, to succeed Prof. Hall; and Frederick Bedell, of Cornell University, was made Secretary of the Council.

The Age of the Earth.—In a recent lecture at the Victoria Institute on the Age of the Globe as an abode fitted for life, Lord Kelvin maintained that if heat had been uniformly conducted out of the earth at its present regular rate, the globe twenty thousand million years ago would have been a molten if not a gaseous mass. A further argument against the huge lengths of time required by the older geologists was sought in the constantly diminishing velocity in the earth's rotation resulting from tidal action. The earth was revolving faster a thousand million years ago than now, and consequently centrifugal action was greater. If the globe had become consolidated while it was traveling at a faster rate, it would have possessed greater oblateness and the length of the equatorial radius would have been six and a half kilometres more than it is. Judging from the properties of rocks and by underground temperatures, the date of the solidification of the earth was probably twenty or thirty million years ago. As to the origin of the atmosphere, at the time of solidification there could have been no free oxygen, so far as could be determined, and no chemical reaction by which it could be liberated. Vegetable life and sunlight must have come into play to prepare our atmosphere in the course of a few hundred or thousand years. A serious geological question was the mode of production of the ocean depths and of the eminences of the continents. Many phenomena were doubtless due to strain on cooling, but that did not afford a sufficient explanation in this case. The author thought the cause was change of density by crystallization. Perhaps the strongest argument against unlimited geological time was afforded by the heat of the sun, which may have illuminated the earth for somewhere about twenty million years. The latest geological estimate of the time required for the formation of all strata since the beginning of the Cambrian rocks was seventeen million years, and the author could hardly be spoken harshly of when he said that this earth could not have been a habitable globe for more than ten million years.

The Musée Social.—The *Musée Social* is a vigorous institution organized in Paris, in 1894, to furnish the public, besides information and discussions, with the documents, models, plans, and statutes of organizations and social institutions intended to ameliorate the material and moral situation of workingmen. It has established a permanent exhibition of social economy, a library of about nine thousand volumes, French and foreign, documents on important questions, and periodicals; and has made provision for communicating to those interested whatever information may be desired concerning social enterprises. For the collection of information it sends deputations to make personal observations of social facts, events, and institutions, and has correspondents abroad, of whom Mr. W. F. Willoughby, of the Department of Labor, represents the United States, to furnish news of the course of the social movements in their respective countries. The results of its inquiries are given to the public through stated conferences held at its rooms in Paris; through "circulars"—very respectable documents in size—published and distributed at short intervals, and through a series of publications known as the *Bibliothèque*, or Library of the *Musée Social*. The Musée has been recognized by the state as of public utility, and its members and supporters are men of weight.

Some Conditions of Plant Distribution.—A paper published by Mr. Conway MacMillan in Minnesota Botanical Studies on the Distribution of Plants along Shore at Lake of the Woods is an admirable demonstration of the dependence over such an area as the shores of the lake of plant formations upon conditions of topography and the environment, is very minute and exhaustive, and is believed by the author to be the first of its kind published in America. From the multitude of illustrations it affords of the dependence of vegetal and other characteristics on small differences of conditions, we can take, almost at random, only a few. The shores of the lake are classified into front, mid, and back strands, etc. "The mid-strand area appears to afford an excellent example of the sensitiveness of plant formations to varying environmental conditions. The character and aspect, the abundance or paucity of certain forms, the arrangement of the different forms with reference to one another, all seem definitely related to the variations in exposure, slope, temperature, moisture, wind currents and surf impact, or upon combinations or modifications of these. So the constant variety of the beach as one walks along it is connected with the multitude of variations in the soil below, the air above, and the water off shore. The mid-strand, too, is modified by the back-strand which abuts upon it. . . . And by the physical texture and contour of the back-strand the mid-strand may be affected very sharply—as when the rain is carried through the gullies in the back-strand down upon or across the area nearer the water's edge. Curious interrupted patches of *Carices* and *Epilobiums* that occur in the mid-strand are often to be referred to declivities or gullies in the back-strand, directing the moisture to some spots rather than to others. Thus both the physical and biological conditions of the zone farther inland affect the beach flora quite as distinctly as do the conditions shoreward." The line between mid-strand and back-strand may be called a tension line, as between two general groups of plants striving to move in opposite directions, where a reciprocal stress is developed; and the plants of the mid-strand strive to enter the back strand, while the others try in turn to work out upon the mid-strand. Thus an irregular boundary line is developed, and the exact line of demarcation is nowhere altogether clear and distinct. A peculiar biological influence modifying back-strand at certain isolated points is the nesting of gulls and terns. "By their deposition of guano, and probably by their carrying in of seeds, these birds have at various points on island back-strand established conditions favorable to the development of vegetation islands that may mark the approximate spot of the rookery long after the birds have deserted it."

The Blue Color of Lakes.—It is generally agreed, as Carl Vogt demonstrated in an article published in the Monthly a few years ago, that pure water, as in many of the deepest lakes, is blue; and it is usually supposed that the greenish tint common to other waters is given to them by yellowish matter held in suspension, while an excess of such matter turns them yellow. The explanation, while he regards it as correct as to the color of water, is not accepted by M. W. Spring as sufficient to account for lakes looking blue; for, if their water is wholly pure and quiet, it will absorb the mass of the light, reflecting little or none, and look black. What gives this water its reflecting power? Some suppose the existence of colorless solid matter in the water like the dust that makes visible the diffused light of the atmosphere. That cause is admitted to be a possible one; but M. Spring has satisfied himself by experiments that water absolutely pure will also reflect the light if the mass is composed of layers of different temperatures that give rise to convection currents. This conclusion is supported by observation. Prof. F. A. Forel has found that fresh-water lakes are more transparent in winter than in summer, as they should be by M. Spring's theory; because in summer the differences in temperature between the surface and the layers beneath are greater. Thus the remains of the lake dwellers can be seen on the bottoms of the Swiss lakes in winter at places where they are not at all visible in summer. Prof. Forel thinks that this is because there is more dust in them to obscure the view in summer than in winter; but there is no reason why this should be, while the disturbance by convection currents is necessarily much greater in the warm season. M. Spring does not interpret his theory as excluding any of the others, but as supplementing them.

At the Head Waters of the Niger.—In the expedition to the sources of the Niger, of which Colonel J. K. Trotter recently gave an account before the Royal Geographical Society, the first station of importance mentioned after leaving Freetown was Kruto, where the chief collected his people and organized a dance in honor of his visitors, himself leading and brandishing an elephant's tail. From a place called Kurubundo, reached several days afterward, there was no road farther on, and the chief set his people to work the whole night to cut a path to a village which the party reached the next day. Descending from the heights at the eastern limits of the British sphere to the Tembi, the travelers entered French territory. The guides here regarded their task as ended, and declined to point out the source of the Tembi, averring that it was the seat of the devil, whom they had no anxiety to meet, though they were devil-worshipers. They believed that any one who looked at the Niger source incurred the wrath of the devil and would die within the year, and they regarded the water as poisonous. Their views concerning the water seemed to be confirmed, but the agency of the devil was not made evident. A marked difference was observed in the aspect of the country in the river valley and outside of it. The part outside of the regular valley was covered with canebrakes ten feet high, yellow and sun-scorched. The moment the valley was reached the bush was green, the foliage abundant, and the trees were covered with creepers and trailers which constituted formidable obstacles. Such differences are characteristic of West Africa. The commission were disappointed at not finding the elevation of the Niger sources higher, 3,379 feet being the maximum recorded. The adjacent country was, however, distinctly mountainous, though none of the summits exceeded six thousand feet. The people in whose country this part of the journey lay exhibited a great love of music. The majority of them were pagans. Occasionally a Mussulman town was passed, and it was remarkable to observe how far the Mohammedans were in advance of the pagans in wealth, comparative civilization, and intelligence. The author regarded all the natives of the west coast, in spite of their defects, which are easily apparent and are in general those of a low order of civilization, as very tractable and quite ready to obey the direction of the Europeans. Their best point is their light-heartedness, which indeed he thinks is the bright spot of West Africa. It is a country where the worst jokes never fail to be appreciated, and where one is certain of bringing down the house without any claim to being a wit.

The Wastes of Civilization.—Improvident Civilization was the subject of the chairman's address by Prof. R. T. Colburn, in the Section of Social and Economic Science of the American Association. Touching the currency question, the speaker observed that when we speak of value, equivalency, wealth, risk, trust, distrust, panic, prosperity, we are dealing not with concrete substances like gold pieces, but with states of mind. Yet these ideas lie at the foundation of commercial exchanges and monetary science. "Have any of you ever imagined what would happen if some modern Rosicrucian should succeed in the turning of base metals cheaply into gold? . . . Such a discovery would introduce into the world of commerce, and indeed into all fiscal relations of men, an appalling confusion: first, by a general rise of prices; and, second, by a dislocation of fixed payments of interest, salaries, and otherwise. Among other curious results we should witness would be a change of sides and tunes between the advocates of the gold and silver standards. . . . The same thing would happen, only more slowly, if a vast deposit of gold were unearthed; and if, after gold was thus discredited by a practically inexhaustible supply, the attempt were made to put silver in its place (the price of which would be enormously enhanced), this state of things would be liable in its turn to be upset by similar discoveries." By precipitating the necessity of inventing some more efficient tool of exchanges, a scientific and more stable enumerator of values, the after benefits to mankind of such an event might compensate for all the disaster it would temporarily cost. The speaker declared our present civilization not abreast of the knowledge of the time and not yielding to mankind nearly the amount of comfort and well-being it might be made to do. As examples of its defects shown in the improvident tendencies of modern life, the speaker cited the waste of warfare and armament, the decadence of races, pernicious competition, spendthrift luxury, the blight of parasitism, the power of superstition, and the diversity of languages.

Legislation against Insects and Fungi.—Referring to the principles upon which legislation against insects and fungi injurious to vegetation rests, and recognizing that such laws are effective only to a limited extent, Garden and Forest suggests that "it does not follow that because the enforcement of a law is not certain it is therefore unwise to enact it. It is true that habitual disobedience to any law breeds to a certain extent contempt for all laws, but it is also true that the expression of the intelligence of a commonwealth on its statute book is of itself an educating force. Laws against forest fires, for instance, help to instruct people who have never given the subject attention as to the enormous amount of property fires sweep away. It has been estimated that a million and a half of dollars every day would not pay for the losses inflicted upon agriculture throughout the United States from insects and fungous diseases. . . . If we are not yet prepared to enforce wholesome laws to prevent this loss, we certainly ought to do everything possible toward creating a sentiment that will enforce them." The assumption on which these laws rest is defined to be that no man has a right to permit his premises to be a breeding ground for pests which will bring loss upon his neighbors when by due diligence he can prevent this. If the trouble does not come from his own carelessness, it is right that the state should pay him as it pays for the destruction of diseased cattle.

Vegetation of the Mammoth Cave.—Notes have been taken by R. Ellsworth Call, during frequent visits to the Mammoth Cave, of its flora; but the list, even including the molds and mildews found growing upon the remains of lunches taken in by parties, is a meager one. The plants are, of course, all cryptogams. Several of the forms occur in the greatest abundance in the region beyond the rivers of the cave, because, probably, many spores are introduced with the lunches. A small *Peziza* on very old, water-soaked timbers in the Mammoth Dome still persists in presenting reddish coloration, notwithstanding that the forms at present found must represent a generation quite remote from the one originally introduced. In some places the great white patches of *Mucor mucedo* are conspicuous by their size and great delicacy. Over the Bottomless Pit this fungus hangs down in long festoons of a white cottony consistence. In other places it runs wild over the soil surrounding decaying timbers. These forms are the most conspicuous in the wastes of the cave, but are often passed by, being mistaken for sheets or balls of white paper. Some of the forms of fungi are common to mines, where they grow under similar conditions to those prevailing in the Mammoth Cave. The constant temperature of the cave, 54°, is somewhat below that adapted to the abundant production of most forms of lower fungi.

Wreaths.—While the modern English limit the use of wreaths to funeral purposes, it was, as Mr. Talfourd Ely shows in his paper read before the Archæological Institute, among the ancients a sign of feasting and joy; and if their dead were crowned, it was to mark them as still partaking of the pleasures of this world. Religion originally prompted the use of the garland, which may have been connected with the widespread belief in the supernatural powers of trees and plants. Wreaths were employed as bandages to assuage headache resulting from debauch, and certain plants were believed to exercise a prophylactic power against the effects of wine. Floral decoration plays a great part in Greek poetry, while among the early Romans the use of wreaths in public was limited to religious functions and as marks of distinction connected with services performed to the state—a function largely derived from the Etruscans. In Greece the single wreath of olive, etc., as a reward for athletes superseded the prizes of intrinsic value offered in heroic times. Wreaths of laurel, myrtle, vine leaves, or flowers, were commonly worn at symposia, and are thus represented on vases. A few such wreaths have been found preserved in Egypt. The manufacture of garlands is depicted in several Pompeiian pictures. Gold crowns were frequently modeled in the form of leaves. Other materials for wreaths were wool and artificial leaves and flowers of horn or silk. Much may be learned about wreaths in the writings of Theophrastus, Plutarch, Pliny, Athenæus, and Gellius, and from inscriptions.

Scenery of Spitzbergen.—Sir William M. Conway and his companions found Spitzbergen, of which they were the first explorers, a very different country from what it was supposed to be. The general impression was that a continuous ice cap would be found, and they expected it; but "in place of a frozen surface they met with crevassed sloppy glaciers, surrounded by miles of quaking bogs and innumerable watercourses"—a perpetual thaw produced by the perpetual day of a brief arctic summer, in a region emerging, as it were, from a glacial epoch. Of course, the opposite conditions of relentless ice prevail in winter. Why should men be attracted to such countries, as arctic explorers who have gone once seem to be time and again? Sir William gives one of the reasons. "The arctic glory," he says, "is a thing apart, wilder, rarer, and no less superb than the glory of any other region of this beautiful world. Here man has no place, and there is no sign of his handiwork. Nature completes her own intentions unhelped and unhindered by him. Such pure snows no Alpine height presents, nor such pale blue skies, nor that marvelous, remote, opalescent sea with its white flocks and its yet more distant shores. No Alpine outlook penetrates through such atmosphere, so mellow, so rich." There are days, the reviewer of Sir William's book in the Athenæum adds—rare days—of glorious cloud effects, when faint mists, delicate and gray, brood on the fiords and almost obliterate the bases of the hills, leaving their tops to stand out clear against a sky mottled with brilliant flocks of cloudlets. The beauties of Spitzbergen are found not as in true mountain regions in the forms of the hills, but in the atmospheric colors and effects. The landscapes have the charm of breadth, of horizontal lines, rather than any sublimity or picturesqueness. "The whole country," says Sir William, "is interesting from a scientific point of view because of the rapidity with which its surface is being modeled into such forms as were impressed in glacial times on the more temperate and inhabited parts of northern Europe."

Dancing Ostriches.—The execution of a kind of waltz is described by Mr. S. C. Cronright Schreiner as a common practice among ostriches. When there are a number of them, they will start off in the morning and, after running a few hundred yards, will stop, and with raised wings will whirl rapidly round till they are stupefied, or perhaps break a leg. The males pose also before fighting and to make their court. They kneel on their ankles, opening their wings, and balancing themselves alternately forward and backward or to one side or the other, while the neck is stretched on a level with the back and the head strikes the sides, now on the right, now on the left, while the feathers are bristling. The bird appears at this time so absorbed in its occupation as to forget all that is going on around him, and can be approached and caught. The male alone utters a cry, which sounds much like an effort to speak with the mouth shut tight. The omnivorous qualities of the ostrich have hardly been exaggerated. It swallows oranges, small turtles, fowls, kittens, and bones. Mr. Schreiner tells of one swallowing also a box of peaches, tennis balls, several yards of fencing wire, and half a dozen cartridges. One followed the workmen and picked up the wire as they cut it. Most frequently the ostrich does not swallow each dainty separately, but collects several in its throat and then swallows them all at once. Sometimes it is strangled. Its windpipe is then cut, the obstacle taken out, and the wound sewed up, when all goes well again.

Gypsum in Kansas.—The gypsum deposits of Kansas are described by Mr. G. P. Grimsley in the Kansas University Quarterly as occurring in a belt that trends northeast-southwest across the State, two hundred and thirty miles long, while the bed of exposed rock increases in width from five miles at the north to thirty-six miles near the southern line. There are three chief areas with intermediate deposits. In the northern or Blue Rapids area the gypsum occurs as a gray, mottled rock, with sugary texture, covered at the top with a layer of white selenite needles forming satin spar, from one fourth of an inch to an inch and a quarter thick. The manufacture of plaster of Paris in Kansas was begun at this place in 1872, with an iron kettle holding about five barrels, heated by a stove. In the Gypsum City area, the lower portion of the bed is dotted with elliptical crystals of yellowish-brown selenite, nearly an inch long and half an inch wide, which give it an appearance somewhat like "bird's-eye limestone." Near Medicine Lodge the red clays and shales below the gypsum contain an interlacing network of selenite and satin-spar layers, which have been dissolved out of the solid stratum and carried down by circulating water. In the western part of the area solution has carved out caves and underground channels, leaving in many places natural bridges of gypsum. The rock is snowy white. Many of the plaster mills use earthy gypsum deposits, which are common, furnishing what is called "gypsum dirt." This is directly calcined, with small labor and expense. These beds, which lie in low, swampy ground, were probably formed by deposits from springs, aided by wash from the hillsides, and are recent. The rock gypsums were deposited in arms of the sea. Eleven mills are engaged in the manufacture of plaster.

Mythological Correspondences.—An attempt has been made by Dr. E. B. Tylor to use correspondence in culture as a means of tracing lines of connection and intercourse between ancient and modern peoples. Good evidence of this class is furnished by mythical beliefs notwithstanding their lack of objective value. The conception of weighing in a spiritual balance the judgment of the dead, first appearing in Egypt, is traced thence in a series of variants from Eastern Buddhism to Western Christendom. The associated doctrine of the Bridge of the Dead, which separates the good passing over from the wicked who fall into the abyss, of the ancient Persian religion, reaches likewise to the extremities of Asia and Europe. Historical ties are practically constituted by these mythical beliefs, which connect the great religions of the world and serve as lines along which their interdependence can be followed. Similar evidences exist of Asiatic influences under which the pre-Columbian civilization of America took shape. In the religion of old Mexico four great scenes in the journey of the soul in the land of the dead are mentioned by early Spanish writers, and are depicted in the Aztec Vatican Codex. They are the crossing of the river, the fearful passage of the soul between two mountains that clash together, the soul's climbing up the mountain set with sharp obsidian knives, and the dangers of the wind carrying such knives in its blast. These pictures correspond with scenes from Buddhist hells or purgatories as depicted on the Japanese temple scrolls. So close and complete analogies of Buddhist ideas in Mexico constitute a correspondence that precludes any explanation except direct transmission from one religion to another. All these and other analogies support the view that the natives of America reached their level of civilization.

A Versatile Man.—A remarkably versatile man, nearly equally eminent as a diplomatist, naturalist, and ethnologist, was Brian Houghton Hodgson, a British officer in the India service, who died in 1894, ninety-four years old. An attack of fever while he was studying at Calcutta sent him to the hill country of Kumaon, where as assessor of the little farms he had to traverse precipitous mountain paths, crossing dangerous rivers with the help of men swimming on gourds or by bridges which were only ladders suspended from cables, became friends with the people, and imbibed a taste for natural history. Next, as assistant in Nepaul, he began the collections of manuscripts, texts, and religious tracts with which he endowed the libraries of Europe and Asia, hunting them up in the archives of Buddhist monasteries and buying them from traffickers and monks. The Buddhist collections of seven of the most famous Orientalist libraries began with these gifts, and Eugène Burnouf, who was indebted to one of these collections for the materials of his great work on the History of Buddhism, said that he collected a larger body of original documents than had up to that time been gathered in either Asia or Europe. He first brought the Thibetan classics within the range of the Indian and European scholar, presenting the libraries with two copies of the collection of three hundred and forty-five folios, one of which was a gift to him from the Grand Lama. His published essays corrected the misinformation and dissipated the fantastic theories that had prevailed on these subjects. Retiring from active service, he went to Darjeeling and engaged in the study of Himalayan natural history. He discovered thirty-nine new genera and species, contributed "a vast number of papers on Himalayan mammals, raised himself . . . to the highest rank among the original ornithologists of the day," and presented collections to a number of societies and museums. An expert is quoted as saying that "in some respects he was in advance of the science of the day. He was fully alive to the importance of geographical distribution, and was the first to attempt a demarcation of the zones of life resulting from differences of elevation in the Himalayas."

MINOR PARAGRAPHS.

A CURIOUS plant is the wild tamarind, or jumbai plant (*Leucæna glauca*), of the river sides and waste places of tropical America; and very strange are its effects upon the non-ruminant animals that feed upon its young shoots, leaves, pods, and seeds, as described in the British Association by Mr. D. Morris, of Kew Gardens. It causes horses to lose the hair from their manes and tails, has a similar effect upon mules and donkeys, and reduces pigs to complete nakedness. Horses are said to recover when fed exclusively on corn and grass, but the new hair is of different color and texture from the old, so that the animal is never quite the same as it was. One instance is cited in which the animal lost its hoofs too, and had to be kept in slings till they grew again and hardened. Ruminant animals are not thus affected, and the growth of the plant is actually encouraged in the Bahamas as a fodder plant for cattle, sheep, and goats. The difference in its action upon ruminants and non-ruminants is probably due to changes effected upon it in the chewing of the cud.

AMONG the events mentioned in the thirtieth report of the Peabody Museum of American Archæology and Ethnology is the completion of the arrangement of the Mary Hemenway collection in such a way that a nearly complete exhibition of the archæology and ethnology of the Pueblo peoples of our Southwest is presented in the upper hall and the gallery on the floor below. Mr. Valk's explorations in New Jersey, enforced by the observations of Prof. G. F. Wright, are mentioned as confirming the opinion that stones worked by man are found in the glacial deposits of the Delaware Valley. Valuable relics have been obtained from the prehistoric sites of Mount Kineo and from the Indians of Maine. Mr. Gordon has examined deposits in Honduras attesting a mixture of several types of culture, and has obtained many objects of interest from the exploration of two caves. His general report on the ruins of Copan, already noticed in the Monthly, is a publication of very great value. Many contributions of literature and specimens, all deserving fuller notices than we can give them, are acknowledged in the report.

PHYSIOLOGICAL experiments are of various kinds, and while some are of such a character as to suggest cruelty unless performed under the most careful guards, there are probably others to which animals may be indifferent, or which may be even agreeable to them. Of the last seems to be one described by Dr. E. A. de Schweinitz in a recent address before the Chemical Society of Washington. "A fine blooded horse, not available for ordinary use on account of his propensity to run away, was converted into a subject for the cultivation of the tuberculin antitoxine. He was, of course, expected to rebel; but, on the contrary, he received the hypodermic injection of the poison of the tuberculosis germ in quietness and even seemed interested in watching the operation. As a burned child dreads the fire, it was supposed he would resist the second operation. But as soon as he observed the doctor appear with the syringe and bottle, he trotted toward him with pleasure, stood quietly looking around with intelligence while the injection was made, and ever afterward lent himself to the experiment with as much evident pleasure and interest as that of the investigators."

Experiments made by Asa S. Kinney at the Hatch Experiment Station, Massachusetts, with special reference to that question, prove that electricity exercises an appreciable influence on the germination of seeds, and that the application of certain strengths of current for short periods of time accelerates the process. The range in the strength of current which accelerates germination is exceedingly limited, and within this range there are a maximum, optimum, and minimum current. Seeds subjected to but one application of electricity show the effect only for a few hours, while, when applied hourly to germinating seeds or growing plants, electricity does not lose its effect, but acts as a constant stimulant to their growth and development.

The movement for instruction in domestic science is finding increasing favor. Provision is gradually being made for it as the demand extends in one institution after another. It is recognized in the Ohio State University in the name of the College of Agriculture and Domestic Science, where a "short course" and a four-year course in the branch are arranged for. The programme of the department, which is under the direction of Miss Perla G. Bowman, of the Toledo Manual Training School, includes cookery in its various branches, with the principles of combustion, food economics, the chemistry of the human body, comparative nutritive and money values of foods, invalid cookery, a waiting course, household economics, the properties of textile materials, sewing, millinery, costumes, dressmaking, and needlework. In connection with these last topics, the choice and treatment of various materials, line, form, color, and texture, as applied to dressmaking, are illustrated in connection with practice. In designing the courses, the need of every woman for the most liberal culture in connection with technical training has been recognized.

An exhibition at the Archæological Institute of England of prehistoric flint implements, discovered in Egypt by Mr. H. W. Seton Karr, includes articles from the mines of the Wady-el-Sheik district, in the Eastern Desert, some of the types of which are new to science, and implements from Abydos, Nagada, Nagh Hamdi, Thebes, and other places in the Western Desert. At some of the mines are shafts about two feet in diameter filled up with drifted sand and surrounded by masses of excavated earth neatly arranged. There was usually a central place where most of the objects were discovered. At some mines a number of clubs or truncheons lay distributed uniformly when the mines were abandoned. Other implements of flint and quartzite are from Somaliland, and were found on a long, low hill about a hundred miles from the coast. The country around was of limestone, in some places overflowed by lava, and the implements lay in ones, twos, and threes. Sir John Evans said, in a communication to the Royal Society, that these discoveries "have an important bearing on the question of the original home of the human race. Of their identity in form with some from the valley of the Somme there can be no doubt, and we need not hesitate in claiming them as palæolithic."

NOTES.

The Columbia University Bulletin notices the retirement, at his own request, of Prof. Thomas Egleston, of the Faculty of Applied Science, the creator of the original School of Mines, of which the faculties of Applied Science have been the outgrowth. Returning from his studies abroad in 1863, he saw that the time was ripe for a school in which chemistry, geology, mineralogy, metallurgy, and engineering might be taught young men with a view to fitting them for practice in the field of mining. The success of the School of Mines was surprising and encouraging. The demand for instruction in allied branches was so great that schools of architecture and engineering and chemistry, etc., were formed and set off in 1896 in the Faculty of Applied Science. What has been done at Columbia has happened to a greater or less extent at several other institutions, so that schools and departments of this sort are multiplying.

The ascent of Mount St. Elias, Alaska, was successfully accomplished by Prince Luigi, of Savoy, and his party of Italian mountain climbers, July 31st. On their way up they met the American party led by Mr. Bryant, who were returning on account of one of their number having been taken ill. The Italians remained two hours on the summit, and took scientific observations and photographs. The height of the mountain was for the first time satisfactorily measured and found to be 18,120 feet. In the previous attempts to ascend this mountain the Topham expedition reached a height of 11,400 feet, and Prof. I. C. Russell, in the second attempt, made under the auspices of the National Geographical Society in 1891, 14,500 feet. Prince Luigi found nothing to indicate that the mountain had ever been a volcano.

The vessel Evelyn Baldwin arrived at Christiania, Norway, August 13th, from Spitzbergen, whence she had sailed northward to 80° 45′ of latitude and until stopped by pack ice. The expedition has secured valuable geological and botanical collections for some American colleges.

Prof. S. P. Langley, Secretary of the Smithsonian Institution, recently attended a meeting of the French Academy of Sciences, and spoke concerning his experiments in mechanical flight. He said he had greatly enlarged the distance which his aëroplanes would run, without much changing his apparatus.

Prof. Wolcott Gibbs, who had been designated president, was not able to be present at the Detroit meeting of the American Association for the Advancement of Science, and Mr. W J McGee took his place as acting president.

A report by Dr. Lambusto Loria on war customs of certain tribes of New Guinea mentions homicide and the "naming of the dead relatives of others" as the two great causes of intertribal war. Homicide is the result of various savage ideas. After a death, "all the gardens and plantations of cocoanuts and betel nuts, etc., belonging to the murdered person are destroyed, to allow the relatives and friends to forget quickly the departed person." Revenge is then decided upon, and preparation is made for it with curious preliminary religious rites.

In a paper in the American Association on the Destruction of Forests and its Effects on Drainage and Agriculture, Mr. H. W. De Courcy advised the farmer. Let him but follow the lines of least grade in his tillage, and "he will soon see the effect of his improved line of cultivation in better crops, greater resistance to droughts by retaining the drainage water, and his young plantations of trees will gladden his sight on the former bare hillside." A safe guide to the line of least grade is the course of a railroad, if there be one through the farm, which always seeks that line.

The French Association for the Advancement of the Sciences recently held its meeting at St. Étienne, and was opened with an address by the president, M. Marey, on The Graphic Method and the Experimental Sciences. The review of the past year's work of the association, read by M. Cartaz, includes notices of studies during the interim of historical geography; of legislation for workingmen, by M. Lebon; of alcoholism, by M. Alglave; a memoir of Pasteur, by M. Brouardel; and a work on bibliography, by Prof. Charles Richet. The death list is rather large, and includes, among the best-known names, those of D'Abbadie, Daubrée, Des Cloiseaux, Schutzenberger, Léon Say, Cernuschi, and Victor Lemoin, physician and geologist.

The Hon. Ralph Abercromby, author of some excellent works on meteorology, including that on Weather in the International Scientific Series, died at Sydney, New South Wales, June 21st, fifty-four years of age.

The death was announced in July of J. J. S. Steenstrup, ex-Professor of Zoölogy and Director of the Zoölogical Museum in Copenhagen, aged eighty-four years. His studies and his books covered a wide field. His principal work was that on the Alternation of Generations. Besides publishing much on natural history, he studied the prehistoric remains found in Denmark, and in conjunction with Sir John Lubbock contributed, in 1866, to the Ethnological Society of London a memoir on the Flint Instruments recently discovered at Persigny-le-Grand.

Prof. Thierry Wilhelm Preyer, formerly of Jena, died in Wiesbaden in July, fifty-six years of age, of Bright's disease. He was distinguished in physiology and psychology. He was born in Manchester, England, in 1841, was taught in London, attended several German universities, and took his degrees at Bonn in 1862 and 1865. He began scientific life as a privat docent at Bonn in 1865, and was appointed Professor of Physiology at Jena at 1869. He retired from this position a few years ago, and went to Berlin and then to Wiesbaden. He was author of a famous work on hæmoglobin; published researches on the mental development of the child, some of which appeared in The Popular Science Monthly, and some form a volume in Appletons' International Education Series; carried on researches in acoustics; investigated the cause of sleep, and published observations on hypnotism; and was the author of Elements of General Physiology.

The distinguished chemist, Prof. Victor Meyer, died at Heidelberg, August 8th. He was born in Berlin in 1848, and was professor successively at Stuttgart, Zurich, Göttingen, and Heidelberg; was author of numerous original researches in organic chemistry, and also contributed to chemical physics, especially in the field of vapor densities.

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